Virginia Electric and Power Company
Richmond, Virginia 23261

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VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNIT 2
CYCLE 8 STARTUP PHYSICS REPORT

Per North Anna Power Station Technical Specification 6.9.1.3 enclosed are five copies of the Virginia Electric and Power Company Technical Report NE-817, "North Anna Unit 2, Cycle 8 Startup Physics Report."

Very truly yours,

W. L. Stewart
Senior Vice President - Nuclear

Enclosures

cc: United States Nuclear Regulatory Commission
Region II
101 Marietta Street, N.W.
Suite 2900
Atlanta, GA 30323

Mr. M. S. Lesser
NRC Senior Resident Inspector
North Anna Power Station

IE26
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North Anna Unit 2 Cycle 8 Startup Physics Report

Nuclear Analysis and Fuel
Nuclear Engineering Services

January, 1991

VIRGINIA POWER

TECHNICAL REPORT NE-817 - Rev. 0

NORTH ANNA UNIT 2, CYCLE 8

STARTUP PHYSICS TEST REPORT

NUCLEAR ANALYSIS AND FUEL
POWER ENGINEERING SERVICES
VIRGINIA POWER

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PREPARED BY: E. A. Hoffman 1/4/91
E. A. Hoffman — Date

REVIEWED BY: Thomas S. Psuik 1/4/91
T. S. Psuik — Date

REVIEWED BY: A. P. Main 1-10-91
A. P. Main — Date

APPROVED BY: D. Dziadosz 1-16-91
D. Dziadosz — Date

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PREFACE

This report presents the analysis and evaluation of the physics tests which were performed to verify that the North Anna 2, Cycle 8 core could be operated safely, and makes an initial evaluation of the performance of the core. It is not the intent of this report to discuss the particular methods of testing or to present the detailed data taken. Standard test techniques and methods of data analysis were used. The test data, results and evaluations, together with the detailed startup procedures, are on file at the North Anna Power Station. Therefore, only a cursory discussion of these items is included in this report. The analyses presented include a brief summary of each test, a comparison of the test results with design predictions, and an evaluation of the results.

The North Anna 2, Cycle 8 Startup Physics Tests Results and Evaluation Sheets are included as an appendix to provide additional information on the startup test results. Each data sheet provides the following information: 1) test identification, 2) test conditions (design), 3) test conditions (actual), 4) test results, 5) acceptance criteria, and 6) comments concerning the test. These sheets provide a compact summary of the startup test results in a consistent format. The design test conditions and design values of the measured parameters were completed prior to the startup physics testing. The entries for the design values were based on the calculations performed by Virginia Electric and Power Company's Nuclear Analysis and Fuel Group[1]. During the tests, the data sheets were used as guidelines both to verify that the proper test conditions were met and to facilitate the preliminary

comparison between measured and predicted test results, thus enabling a quick identification of possible problems occuring during the tests.

SECTION 1

INTRODUCTION AND SUMMARY

On August 21, 1990 Unit No. 2 of the North Anna Power Station shutdown for its seventh refueling. During this shutdown, 78 of the 157 fuel assemblies in the core were replaced with 64 fresh fuel assemblies and 14 twice burned fuel assemblies. The eighth cycle core consists of 14 sub-batches of fuel: four once-burned batches from Cycle 7 (batches 9A, 9B, N1/10A and N1/10B); seven twice-burned batches, one from North Anna 1 Cycles 3 and 4 (batch N1/5), one from North Anna 2 Cycle 5 and North Anna 1 Cycle 4 (batch N1/6), one from North Anna 1 Cycles 5 and 6 (batch N1/7), one from North Anna 2 Cycles 2 and 3 (batch 4), one from North Anna 2 Cycles 3 and 4 (batch 5A), and two from North Anna 2 Cycles 6 and 7 (batches 8A and 8B); one thrice-burned batch from North Anna 2 Cycles 5, 6, and 7 (batch 7A); and two fresh batches (batches 10A and 10B). The core loading pattern and the design parameters for each batch are shown in Figure 1.1. Fuel assembly burnups are given in Figure 1.2. The incore instrumentation locations are identified in Figure 1.3. Figure 1.4 identifies the location and number of burnable poison rods and source assemblies for Cycle 8, and Figure 1.5 identifies the location and number of control rods in the Cycle 8 core.

On November 1, 1990 at 1735, the eighth cycle core achieved initial criticality. Following criticality, startup physics tests were performed as outlined in Table 1.1. A summary of the results of these tests follows:

1. The measured drop time of each control rod was within the 2.7 second limit of Technical Specification 3.1.3.4.

2. Individual control rod bank worths were measured using the rod swap technique[2] and the results were within 4.7% or 30 pcm of the design predictions. The sum of the individual measured control rod bank worths was within 1.0% of the design prediction. These results are within the design tolerance of ±15% or ±100 pcm for individual bank worths (±10% for the rod swap reference bank worth) and the design tolerance of ±10% for the sum of the individual control rod bank worths.

3. Measured critical boron concentrations for two control bank configurations were within 10 ppm of the design predictions. These results were within the design tolerances and also met the Technical Specification 4.1.1.1.2 criterion that the overall core reactivity balance shall be within ±1% Δk/k of the design prediction.

4. The boron worth coefficient measurement was within 1.4% of the design prediction, which is within the design tolerance of ±10%.

5. The measured isothermal temperature coefficient (ITC) for the all-rods-out configuration was within 0.87 pcm/°F of the design prediction. This result is within the design tolerance of ±3 pcm/°F. The measured ITC of -1.37 pcm/°F meets the Technical Specification 3.1.1.4 criterion that the moderator temperature coefficient (MTC) be less than or equal to +6.0 pcm/°F. When the

Doppler temperature coefficient and a 0.5 pcm/°F uncertainty are accounted for in the MTC limit, the MTC requirement is satisfied as long as the ITC is less than or equal to +3.75 pcm/°F.

6. Mode 1 (See Reference 4) core power distributions were within established design tolerances. Generally, the measured core power distribution was within 2.2% of the design predictions. The heat flux hot channel factors, F-Q(T), and enthalpy rise hot channel factors, F-DH(M), were within the limits of Technical Specifications 3.2.2 and 3.2.3, respectively.

In summary, all startup physics test results were acceptable. Detailed results, specific design tolerances and acceptance criteria for each measurement are presented in the following sections of this report.

Table 1.1

NORTH ANNA 2 - CYCLE 8 STARTUP PHYSICS TESTS
CHRONOLOGY OF TESTS

Test	Date	Time	Power	Reference Procedure
Hot Rod Drop - Hot Full Flow	10/31/90	2330	HSD	2-PT-17.2
Zero Power Testing Range	11/01/90	1800	HZP	2-PT-94.0
Reactivity Computer Checkout	11/01/90	1831	HZP	2-PT-94.0
Boron Endpoint - ARO	11/01/90	2110	HZP	2-PT-94.0
Temperature Coefficient - ARO	11/01/90	2154	HZP	2-PT-94.0
Bank B Worth	11/02/90	0008	HZP	2-PT-94.0
Boron Endpoint - B in	11/02/90	0330	HZP	2-PT-94.0
Bank D Worth - Rod Swap	11/02/90	0456	HZP	2-PT-94.0
Bank C Worth - Rod Swap	11/02/90	0657	HZP	2-PT-94.0
Bank A Worth - Rod Swap	11/02/90	0752	HZP	2-PT-94.0
Bank SB Worth - Rod Swap	11/02/90	0815	HZP	2-PT-94.0
Bank SA Worth - Rod Swap	11/02/90	0909	HZP	2-PT-94.0
Flux Map - [illegible]% Power	11/04/90	1530	28%	2-PT-21.1
Flux Map - QPTR Verification	11/07/90	2300	72%	2-PT-21.1
Flux Map - QPTR Verification	11/08/90	1830	90%	2-PT-21.1
Flux Map - HFP	11/14/90	1400	100%	2-PT-21.1
Flux Map - I/E Calibration	11/15/90	0600	100%	2-PT-22.2
Flux Map - I/E Calibration	11/15/90	1700	100%	2-PT-22.2

Figure 1.1

NORTH ANNA UNIT 2 - CYCLE 8
CORE LOADING MAP

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							5A S31	8B W50	5A S24						
2					8A W17	N1/10A K06	10B Y33	9B X37	10B Y56	N1/10A K01	8A W13				
3				7A V22	10B Y60	10A Y02	9B X39	10B Y39	9B X24	10A Y26	10B Y43	7A V01			
4			7A V26	9B X46	10B Y42	9A X18	10B Y48	9A X07	10B Y64	9A X08	10B Y53	9B X52	7A V35		
5		8A W14	10B Y34	10B Y51	N1/10A K11	10A Y09	9B X50	9B X33	9B X32	10A Y17	N1/10A K05	10B Y36	10B Y58	8A W11	
6		N1/10A K10	10A Y07	9A X01	10A Y20	9A X13	10A Y24	N1/5 E13	10A Y03	9A X03	10A Y27	9A X11	10A Y11	N1/10A K09	
7	5A S56	10B Y55	9B X48	10B Y63	9B X41	10A Y16	9B X40	10A Y21	9B X35	10A Y14	9B X42	10B Y61	9B X47	10B Y46	5A S06
8	8B W38	9B X25	10B Y45	9A X17	9B X45	4 R27	10A Y13	N1/7 G30	10A Y05	4 R18	9B X51	9A X06	10B Y32	9B X31	8B W64
9	5A S34	10B Y29	9B X34	10B Y38	9B X43	10A Y23	9B X22	10A Y18	N1/10B K41	10A Y28	9B X29	10B Y41	9B X49	10B Y54	5A S36
10		N1/10A K07	10A Y12	9A X05	10A Y04	9A X15	10A Y06	N1/5 E58	10A Y22	9A X02	10A Y01	9A X16	10A Y08	N1/10A J04	
11		8A W18	10B Y52	10B Y35	N1/10A K02	10A Y19	9B X30	9B X28	9B X36	10A Y15	N1/10A K08	10B Y57	10B Y37	8A W23	
12			N1/6 F57	9B X26	10B Y62	9A X20	10B Y50	9A X04	10B Y59	9A X14	10B Y31	9B X23	7A V32		
13				7A V10	10B Y44	10A Y10	9B X38	10B Y40	9B X21	10A Y25	10B Y47	7A V36			
14					8A W16	N1/10A K03	10B Y30	9B X27	10B Y49	N1/10A K12	8A W04				
15							5A S02	8B W43	5A S41						

--> BATCH
--> ASSEMBLY ID

FUEL ASSEMBLY DESIGN PARAMETERS

	SUB-BATCH													
	N1/5	N1/6	N1/7	N1/10A	N1/10B	4	5A	7A	8A	8B	9A	9B	10A	10B
INITIAL ENRICHMENT (W/O U-235)	3.40	3.59	3.60	3.80	4.00	3.41	3.59	3.60	3.79	4.00	3.80	4.01	3.99	4.21
BURNUP AT BOC 8 (MWD/MTU)	22603	37921	34556	23945	23443	23869	33687	38225	34997	35465	23632	20543	0	0
ASSEMBLY TYPE	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17	17x17
NUMBER OF ASSEMBLIES	2	1	1	12	1	2	8	7	8	4	16	31	28	36
FUEL RODS PER ASSEMBLY	264	264	264	264	264	264	264	264	264	264	264	264	264	264

Figure 1.2

NORTH ANNA UNIT 2 - CYCLE 8
BEGINNING OF CYCLE FUEL ASSEMBLY BURNUPS

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							V31 33727	W50 35281	S24 33931						
2					W17 34690	K06 24083	Y33 0	X37 19107	Y56 0	K01 24253	W13 34875				
3				V22 38065	Y60 0	Y02 0	X39 18618	Y39 0	X24 8730	Y26 0	Y43 0	V01 38735			
4			V26 38327	X46 18860	Y42 0	X18 23955	Y48 0	X07 23746	Y65 0	X08 23755	Y53 0	X52 [illegible]	V35 37435		
5		W14 34727	Y34 0	Y61 0	K11 25603	Y09 0	X5[illegible] 23522	X33 22895	X32 21941	Y17 0	K05 23731	Y36 0	[illegible] 0	W11 34940	
6		K10 23911	Y07 0	X01 24161	Y20 0	X13 22679	Y24 0	E13 22237	Y03 0	X03 22951	Y27 0	X11 23941	Y11 0	K09 24829	
7	S56 33765	Y55 0	X48 18684	Y63 0	X41 21717	Y16 0	X40 22509	Y21 0	X35 22718	Y14 0	X42 21[illegible]83	Y61 0	X47 18438	Y46 0	S06 33501
8	W38 35601	X25 20087	Y45 0	X17 23803	X45 22937	R[illegible]7 23861	Y13 0	G30 34556	Y05 0	R18 23827	X51 23099	X06 23908	Y32 0	X31 19429	W69 35593
9	S34 33724	Y29 0	X34 18378	Y58 0	X43 21078	Y23 0	X22 23228	Y18 0	K41 23443	Y28 0	X29 22037	Y41 0	X49 18896	Y54 0	S36 33476
10		K07 24201	Y12 0	X05 24018	Y04 0	X15 22986	Y06 0	E58 22969	Y22 0	X02 22977	Y01 0	X16 23773	Y08 0	K04 2[illegible]036	
11		W18 34954	Y52 0	Y35 0	K02 23773	Y19 0	X30 22084	X28 22823	X36 21240	[illegible]15 0	K08 23495	Y57 0	Y37 0	W23 35064	
12			F57 37921	X26 19246	Y62 0	X20 23844	Y50 0	X04 23733	Y59 0	X14 2394[illegible]	Y31 0	X23 19550	V32 38675		
13				V10 38816	Y44 0	Y10 0	X38 18753	Y40 0	X21 1[illegible]193	Y25 0	Y47 0	V36 37523			
14					W16 35776	K03 24024	Y30 0	X27 18968	Y49 0	K12 24004	W04 34949				
15							S02 33369	W43 35385	S42 33386						

|--> ASSEMBLY ID
|--> ASSEMBLY BURNUP

Figure 1.3

NORTH ANNA UNIT 2 - CYCLE 8
INCORE INSTRUMENTATION LOCATIONS

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1								MD	TC						
2							TC		TC	MD					
3				MD TC		TC	MD	MD TC		TC		MD TC			
4					MD			MD		MD	TC				
5			MD		MD	TC	MD	TC		TC	MD	MD TC		MD TC	
6			TC		MD TC			MD	TC	MD					
7	[illegible]	TC	MD								TC	MD		MD	
8		TC	MD TC		MD TC	TC		TC	TC	MD	TC		MD TC	MD	TC
9				TC	MD			TC		MD TC					MD
10			MD TC				MD TC				TC	MD		[illegible]	
11				TC	MD	TC		MD TC		MD TC	MD				
12			[illegible]		TC		MD TC				TC	MD	MD TC		
13								MD TC		MD TC					
14					TC				MD		TC				
15							MD	TC	TC						

MD = Movable Detector
TC = Thermocouple

Figure 1.4

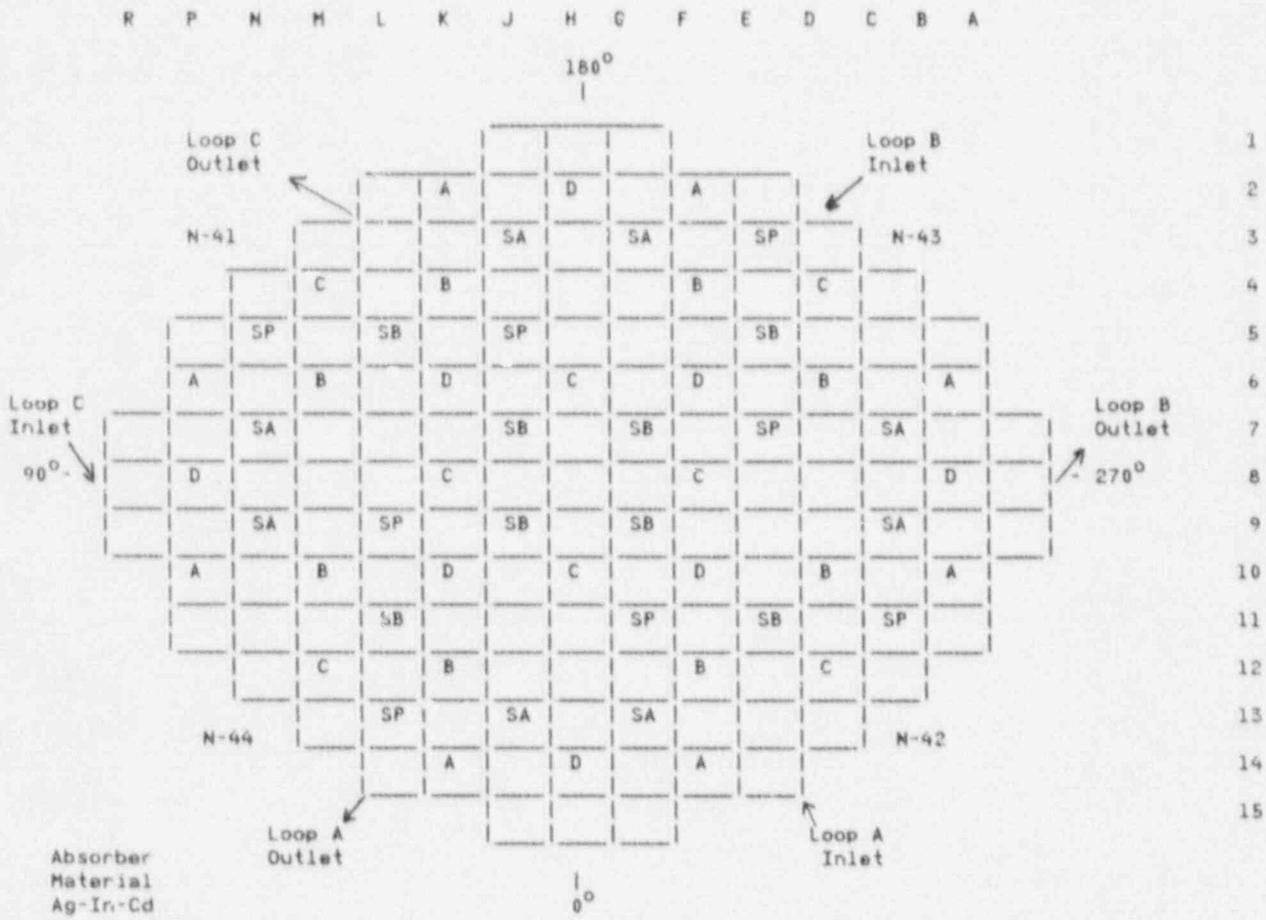
NORTH ANNA UNIT 2 - CYCLE 8
BURNABLE POISON AND SOURCE ASSEMBLY LOCATIONS

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1															
2							4P		4P						
3					P	12P		20P		12P	7P				
4					16P		20P		20P						
5			7P	16P		20P				20P		16P	7P		
6			12P		20P		16P		16P		20P		12P		
7		4P		20P		16P		16P		16P		20P		4P	
8			20P		SS17		16P		16P		SS18		20P		
9		4P		20P		16P		16P		16P		20P		4P	
10			12P		20P		16P		16P		20P		12P		
11			7P	16P		20P				20P		16P	7P		
12					16P		20P		20P		16P				
13					7P	12P		20P		12P	7P				
14							4P		4P						
15															

4P - 4 BURNABLE POISON ROD CLUSTER
7P - 7 BURNABLE POISON ROD CLUSTER
12P - 12 BURNABLE POISON ROD CLUSTER
16P - 16 BURNABLE POISON ROD CLUSTER
20P - 20 BURNABLE POISON ROD CLUSTER
SSxx - SECONDARY SOURCE

Figure 1.5

NORTH ANNA UNIT 2 - CYCLE 8
CONTROL ROD LOCATIONS



Function	Number of Clusters
Control Bank D	8
Control Bank C	8
Control Bank B	8
Control Bank A	8
Shutdown Bank SB	8
Shutdown Bank SA	8
SP (Spare Rod Locations)	8

SECTION 2

CONTROL ROD DROP TIME MEASUREMENTS

The drop time of each control rod was measured at hot full-flow reactor coolant system (RCS) conditions in order to verify that the time from initiation of the rod drop to the entry of the rod into the dashpot was less than or equal to the maximum allowed by Technical Specification 3.1.3.4. The control rod drop times were measured in Mode 3* with RCS Tavg above 500°F and all reactor coolant pumps operating.

The rod drop times were measured by withdrawing a rod bank to its fully withdrawn position, and removing the movable gripper coil fuse and stationary gripper coil fuse for the particular rod of the bank to be dropped. This allowed the rod to drop into the core as it would during a plant trip. The stationary gripper coil voltage and the Individual Rod Position Indication (IRPI) primary coil voltage signals were recorded to determine the the rod drop time. This procedure was repeated for each control rod.

As shown on the sample rod drop trace in Figure 2.1, the initiation of the rod drop is indicated by the decay of the stationary gripper coil voltage when the stationary gripper coil fuse is removed. As the rod drops, a voltage is induced in the IRPI primary coil. The magnitude of this voltage is a function of control rod velocity. As the rod enters the dashpot region of the guide tube, its velocity slows causing a voltage decrease in the IRPI coil. This voltage reaches a minimum when the rod reaches the bottom of the dashpot. Subsequent variations in the trace are caused by rod bouncing.

The measured drop times for each control rod are recorded on Figure 2.2. The slowest, fastest, and average drop times are summarized in Table 2.1. Technical Specification 3.1.3.4 specifies a maximum rod drop time from loss of stationary gripper coil voltage to dashpot entry of 2.7 seconds with the RCS at hot, full flow conditions. These test results satisfied this 'imit.

Table 2.1

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
HOT ROD DROP TIME SUMMARY

ROD DROP TIME TO DASHPOT ENTRY

SLOWEST ROD	FASTEST ROD	AVERAGE TIME
B-06 1.80 sec.	C-09 1.44 sec.	1.59 sec.

Figure 2.1
NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
TYPICAL ROD DROP TRACE

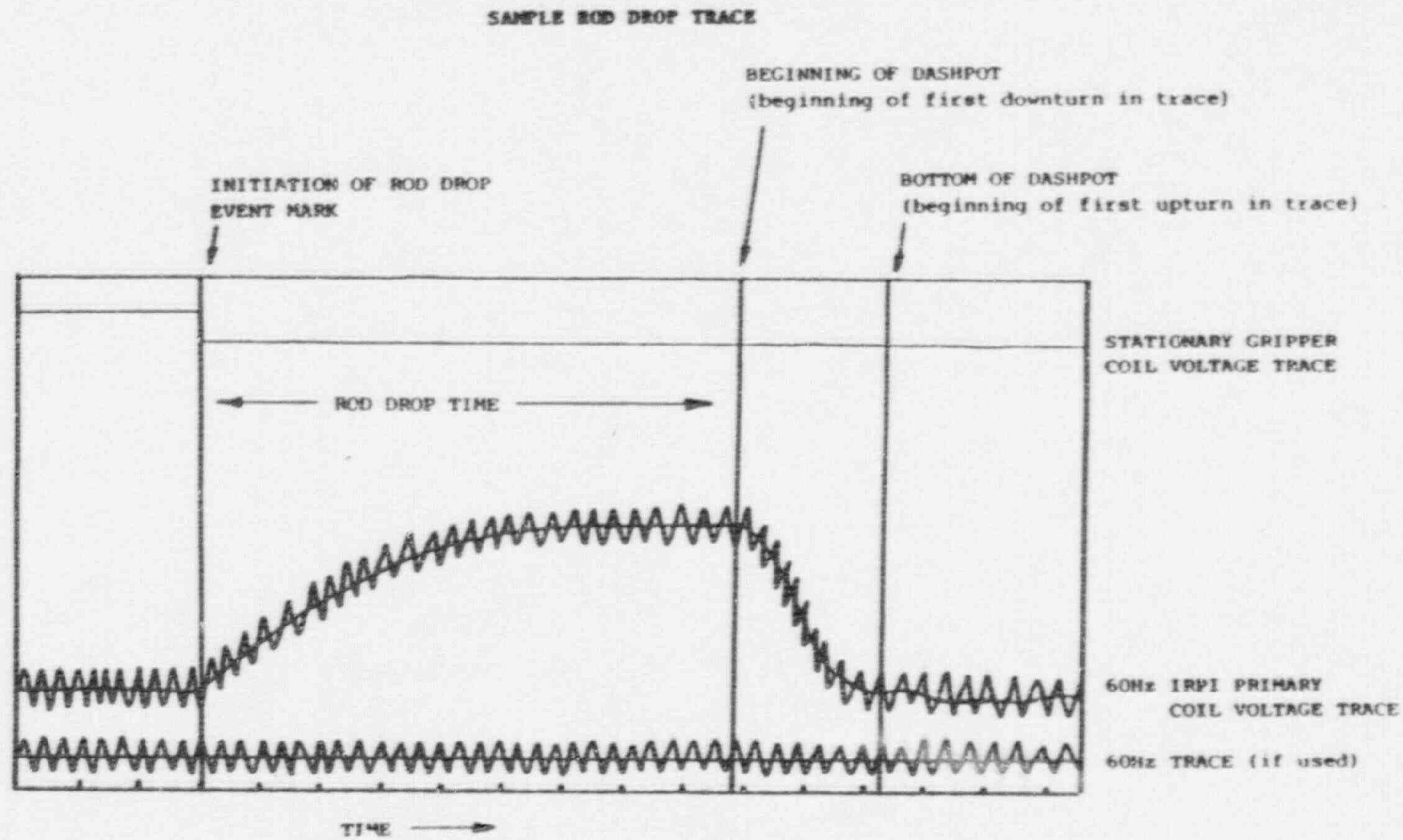


Figure 2.2

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
ROD DROP TIME - HOT FULL FLOW CONDITIONS

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1															
2						1.62		1.63		1.59					
3							1.58		1.55						
4				1.46		1.64				1.58		1.64			
5					1.56						1.58				
6		1.58		1.62		1.57		1.58		1.58		1.58		1.80	
7			1.53				1.54		1.53				1.60		
8		1.65				1.61				1.54				1.70	
9			1.61				1.53		1.54				1.44		
10		1.65		1.54		1.59		1.59		1.54		1.62		1.59	
11					1.59						1.53				
12				1.62		1.58				1.53		1.66			
13							1.57		1.59						
14						1.74		1.62		1.70					
15															

| X.XX | --> ROD DROP TIME TO DASHPOT ENTRY (SEC)

SECTION 3

CONTROL ROD BANK WORTH MEASUREMENTS

Control rod bank worths were measured for the control and shutdown banks using the rod swap technique[2]. The initial step of the rod swap method diluted the predicted most reactive control rod bank (hereafter referred to as the reference bank) into the core and measured its reactivity worth using conventional test techniques. The reactivity changes resulting from the reference bank movements were recorded continuously by the reactivity computer and were used to determine the differential and integral worth of the reference bank. For Cycle 8, Control Bank B was used as the reference bank.

After the completion of the reference bank reactivity worth measurement, the reactor coolant system temperature and boron concentration were stabilized with the reactor just critical and the reference bank near full insertion. Initial statepoint data for the rod swap maneuver were obtained by moving the reference bank to its fully inserted position and recording the core reactivity and moderator temperature. From this point, a rod swap maneuver was performed by withdrawing the reference bank several steps and then one of the other control rod banks (i.e., a test bank) was inserted to balance the reactivity of the reference bank withdrawal. This sequence was repeated until the test bank was fully inserted and the reference bank was positioned such that the core was just critical. This measured critical position (MCP) of the reference bank with the test bank fully inserted was used to determine the integral reactivity worth of the test bank.

The core reactivity, moderator temperature, and the differential worth of the reference bank were recorded with the reference bank at the MCP. The rod swap maneuver then was repeated in reverse such that the reference bank again was near full insertion with the test bank fully withdrawn from the core. This rod swap process was then repeated for each of the other control and shutdown banks.

A summary of the test results is given in Table 3.1. As shown in this table and the Startup Physics Tests Results and Evaluation Sheets given in the Appendix, the individual measured bank worths for the control and shutdown banks were within the design tolerance (±10% for the reference bank, ±15% for each test bank worth greater than 600 pcm, and ±100 pcm for each test bank worth of less than 600 pcm). The sum of the individual measured rod bank worths was within 1.0% of the design prediction. This is well within the design tolerance of ±10% for the sum of the individual control rod bank worths.

The integral and differential reactivity worths of the reference bank (Control Bank B) are shown in Figures 3.1 and 3.2, respectively. The design predictions and the measured data are plotted together in order to illustrate their agreement. In summary, the measured rod worth values were satisfactory.

Table 3.1

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
CONTROL ROD BANK WORTH SUMMARY

BANK	MEASURED WORTH (PCM)	PREDICTED WORTH (PCM)	PERCENT DIFFERENCE (%) (M-P)/P X 100
B-Reference Bank	1259.9	1264.0	-0.3
D	1025.7	999.0	2.7
C	710.3	739.8	-4.0
A	330.5	307.7	7.4 *
SB	976.6	996.4	-2.0
SA	1061.7	1014.1	4.7
Total Worth	5364.7	5321.0	0.8

* Difference is less than 100 pcm.

Figure 3.1

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
BANK B INTEGRAL ROD WORTH - HZP
ALL OTHER RODS WITHDRAWN

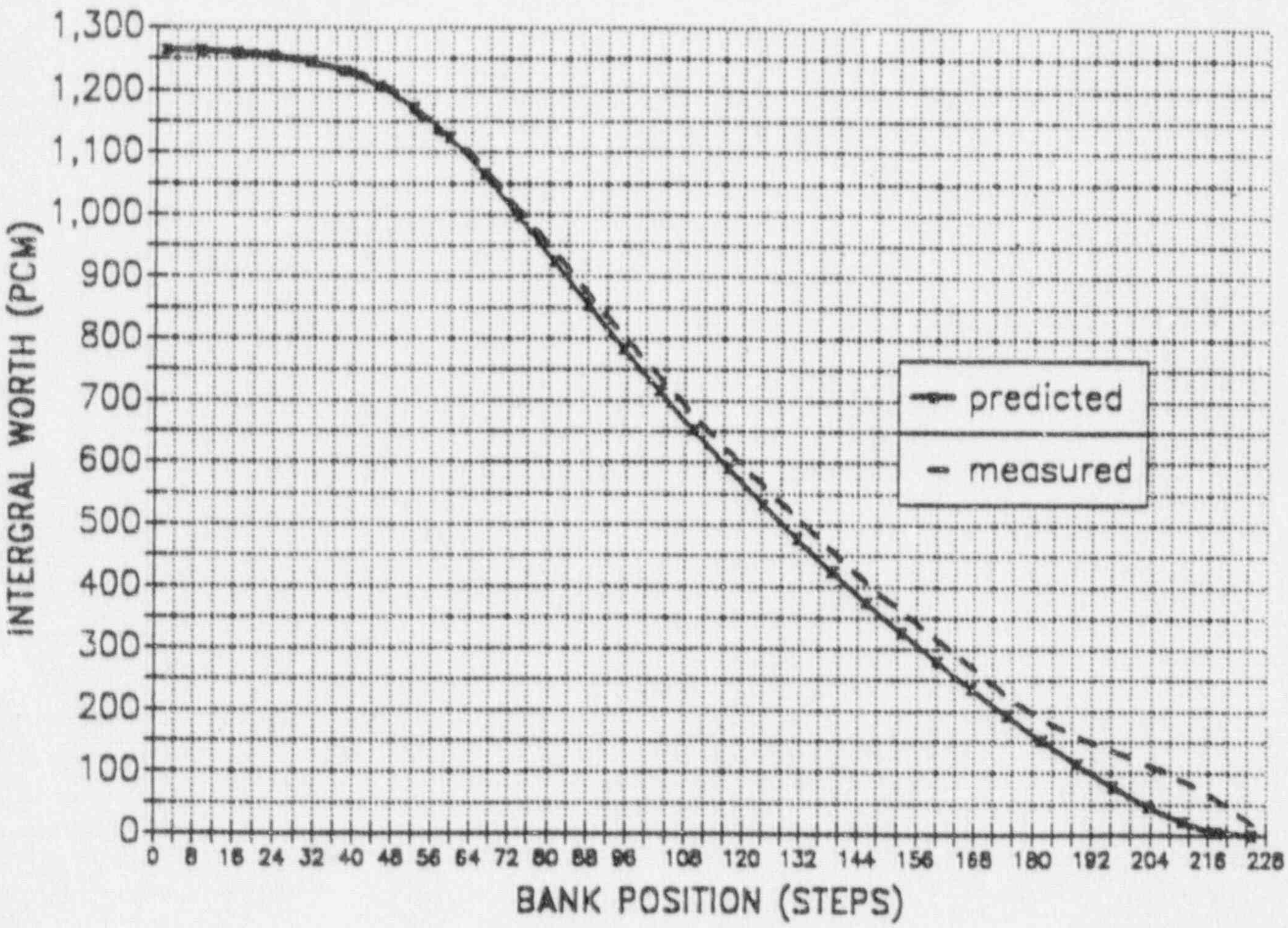
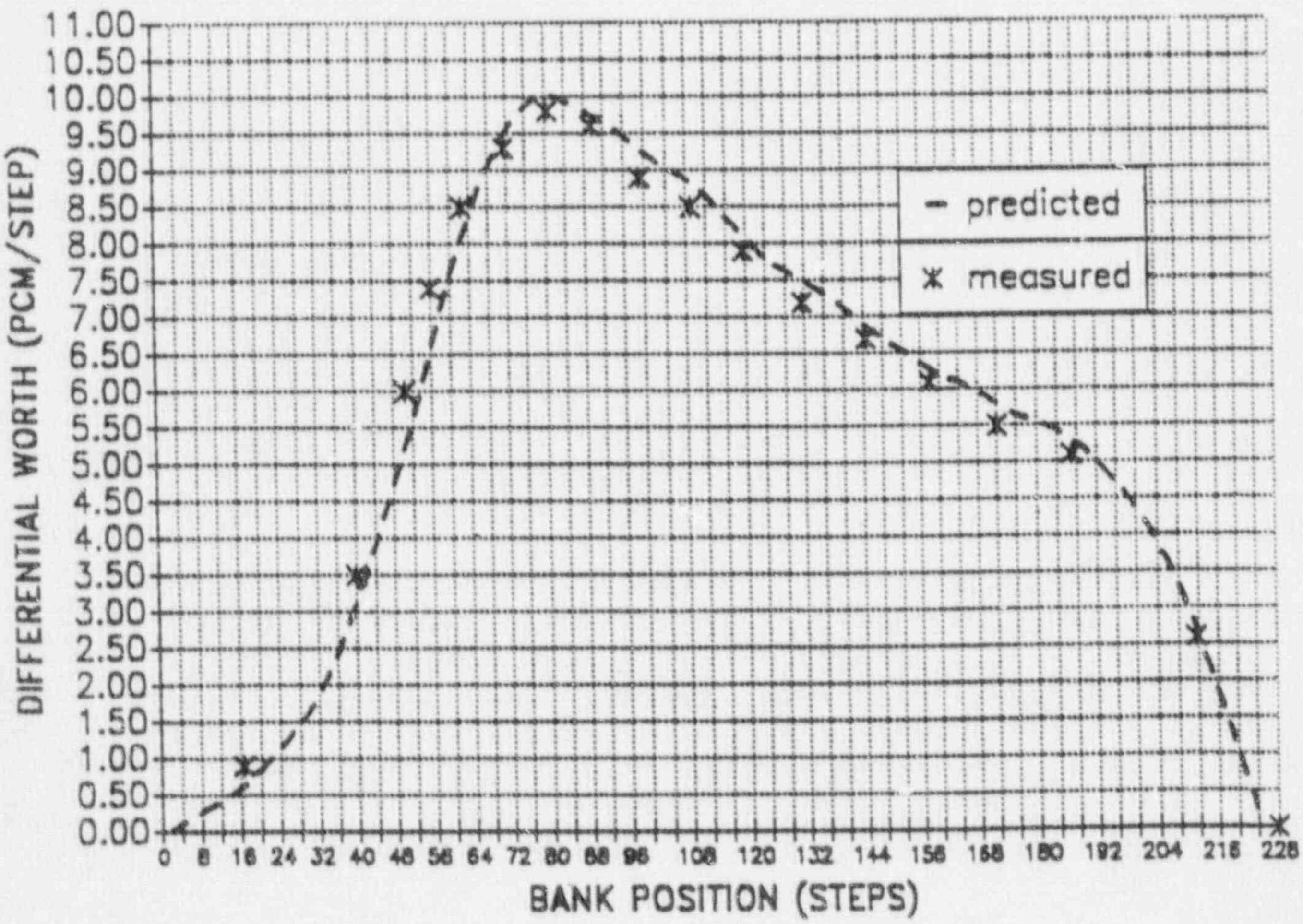


Figure 3.2

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
BANK B DIFFERENTIAL ROD WORTH - HZP
ALL OTHER RODS WITHDRAWN



SECTION 4

BORON ENDPOINT AND WORTH MEASUREMENTS

Boron Endpoint

With the reactor critical at hot zero power, reactor coolant system (RCS) boron concentrations were measured at selected rod bank configurations to enable a direct comparison of measured boron endpoints with design predictions. For each critical boron concentration measurement, the RCS conditions were stabilized with the control banks at or very near a selected endpoint position. Adjustments to the measured critical boron concentration values were made to account for off-nominal control rod position and moderator temperature, if necessary.

The results of these measurements are given in Table 4.1. As shown in this table and in the Startup Physics Tests Results and Evaluation Sheets given in the Appendix, the measured critical boron endpoint values were within their respective design tolerances and met the requirements of Technical Specification 4.1.1.1.2 regarding core reactivity balance. In summary, the boron endpoint results were satisfactory.

Boron Worth Coefficient

The measured boron endpoint values provide stable statepoint data from which the boron worth coefficient or differential boron worth (DBW) was determined. By relating each endpoint concentration to the integrated rod worth present in the core at the time of the endpoint measurement, the value of the DBW over the range of boron endpoint concentrations was obtained.

A plot of the boron concentration versus inserted control rod worth is shown in Figure 4.1. As indicated in this figure and in the Appendix, the DBW measured was -7.04 pcm/ppm. This is within 1.4% of the predicted value of -6.94 pcm/ppm and is well within the design tolerance of ±10%. In summary, the measured boron worth coefficient was satisfactory.

Table 4.1

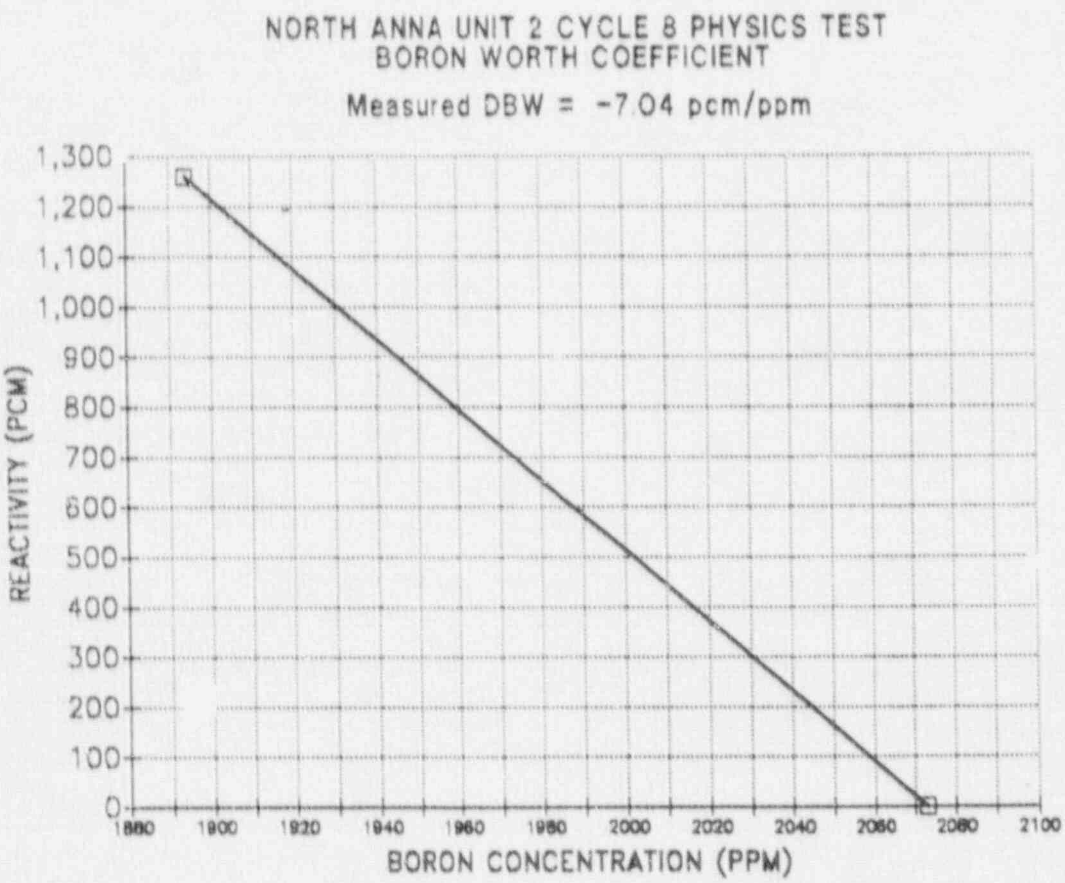
NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
BORON ENDPOINTS SUMMARY

Control Rod Configuration	Measured Endpoint (ppm)	Predicted Endpoint (ppm)	Difference M-P (ppm)
ARO	2073	2063	+10
B Bank In	1894	1890*	+4

* The predicted endpoint for the B Bank In configuration was adjusted for the difference between the measured and predicted values of the endpoint taken at the ARO configuration as shown in the boron endpoint Startup Physics Test Results and Evaluation Sheets in the Appendix.

Figure 4.1

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
BORON WORTH COEFFICIENT



SECTION 5

TEMPERATURE COEFFICIENT MEASUREMENT

The isothermal temperature coefficient (ITC) at the all-rods-out condition is measured by controlling the reactor coolant system (RCS) temperature with the steam dump valves to the condenser, establishing a constant heatup or cooldown rate, and monitoring the resulting reactivity changes on the reactivity computer. Typically, this test sequence includes a cooldown followed by a heatup; however, the heatup ITC was not within 1 pcm/°F of the cooldown ITC as specified in Station Procedure 2-PT-94.0, therefore; a second cooldown was done to remeasure the ITC.

Reactivity was measured during both RCS cooldowns of approximately 2.8°F. Reactivity and temperature data was taken from the reactivity computer and strip chart recorders. Using the statepoint method, the temperature coefficient was determined by dividing the change in reactivity by the change in RCS temperature An X-Y plotter, which plotted reactivity versus temperature, confirmed the statepoint method in calculating the measured ITC.

The predicted and measured isothermal temperature coefficient values are compared in Table 5.1. As can be seen from this summary and from the Startup Physics Test Results and Evaluation Sheet given in the Appendix, the measured isothermal temperature coefficient value was within the

design tolerance of ±3 pcm/°F and met the requirements of Technical Specification 3.1.1.4. In summary, the measured result was satisfactory.

Table 5.1

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
ISOTHERMAL TEMPERATURE COEFFICIENT SUMMARY

BANK POSITION	TEMPERATURE RANGE (°F)	BORON CONCENTRATION (ppm)	ISOTHERMAL TEMPERATURE COEFFICIENT (PCM/°F)				
			C/D #1	C/D #2	AVE. MEAS.	PRED.	DIFFER. (M-P)
D/228	543.5 to 546.3	2083	-1.25	-1.48	-1.37	-0.50	-0.87

SECTION 6

POWER DISTRIBUTION MEASUREMENTS

The core power distributions were measured using the movable incore detector flux mapping system. This system consists of five fission chamber detectors which traverse fuel assembly instrumentation thimbles in 46 core locations (see Figure 1.3). For each traverse, the detector voltage output is continuously monitored on a strip chart recorder, and scanned for 61 discrete axial points by the PRODAC P-250 process computer. Full core, three-dimensional power distributions are determined from this data using the Westinghouse computer program, INCORE[3]. INCORE couples the measured voltages with predetermined analytic power-to-flux ratios in order to determine the power distribution for the whole core.

A list of the full-core flux maps taken during the startup test program and the measured values of the important power distribution parameters is given in Table 6.1. A comparison of these measured values with their Technical Specification limits is given in Table 6.2. Flux Map 1 was taken at 28% power to verify the radial power distribution (RPD) predictions at low power. Figure 6.1 shows the measured RPDs from this flux map. Flux maps 2, 3 and 4 were taken at 72%, 90% and 100% power levels with different control rod configurations. These flux maps were taken to check at-power design predictions and to measure core power distributions at various operating conditions. The radial power distributions for these maps are given in Figures 6.2, 6.3 and 6.4. These figures show that the measured relative assembly power values were generally within 2.2% of the predicted values. Further, the measured F-Q(T) and F-DH(M) peaking factor values for the at-power flux maps were

within the limits of Technical Specifications 3.2.2 and 3.2.3, respectively.

In conclusion, the power distribution measurement results were considered to be acceptable with respect to the design tolerances, the accident analysis acceptance criteria, and the Technical Specification limits. It is therefore anticipated that the core will continue to operate safely throughout Cycle 8.

TABLE 6.1

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
INCORE FLUX MAP SUMMARY

MAP DESCRIPTION	MAP NO.	DATE	BURN UP MWD/MTU	PWR (%)	BANK D STEPS	F-Q(T) HOT CHANNEL FACTOR [1]				F-DH(N) HOT CHNL.FACTOR			CORE F(Z) MAX		QPTR [2]		AXIAL OFF SET (%)	NO. OF THIMBLES
						ASSY	PIN	AXIAL POINT	F-Q(T)	ASSY	PIN	F-DH(N)	AXIAL POINT	F(Z)	MAX	LOC		
LOW POWER	1	11-04-90	18	28	150	L 4	PI	30	2.237	L 4	PI	1.523	30	1.372	1.011	NW	-3.26	43
QPTR VERIFICATION	2	11-07-90	63	72	185	H 3	IH	29	2.041	J 4	HI	1.443	28	1.302	1.011	NW	1.05	46
QPTR VERIFICATION	3	11-08-90	88	90	204	L 4	PI	29	1.923	L 4	PI	1.423	29	1.237	1.008	NW	0.16	46
HOT FULL POWER	4	11-14-90	315	100	228	F 3	EE	36	1.888	F 3	EE	1.414	36	1.222	1.006	NW	-1.36	46

NOTES: HOT SPOT LOCATIONS ARE SPECIFIED BY GIVING ASSEMBLY LOCATIONS (E.G. H-8 IS THE CENTER-OF-CORE ASSEMBLY), FOLLOWED BY THE PIN LOCATION (DENOTED BY THE "Y" COORDINATE WITH THE SEVENTEEN ROWS OF FUEL RODS LETTERED A THROUGH R AND THE "X" COORDINATE DESIGNATED IN A SIMILAR MANNER).
IN THE "Z" DIRECTION THE CORE IS DIVIDED INTO 61 AXIAL POINTS STARTING FROM THE TOP OF THE CORE.

1. F-Q(T) INCLUDES A TOTAL UNCERTAINTY OF 1.05 X 1.03.

2. QPTR - QUADRANT POWER TILT RATIO.

3. MAPS 5 AND 6 WERE QUARTER-CORE FLUX MAPS TAKEN FOR INCORE/EXCORE CALIBRATION. (I/E CALIBRATION)

Table 6.2

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
COMPARISION OF MEASURED POWER DISTRIBUTION PARAMETERS
WITH THEIR TECHNICAL SPECIFICATION LIMITS

MAP NO.	F-Q(T) HOT CHANNEL FACTOR*			F-DH(M) HOT CHANNEL FACTOR		
	MEAS	LIMIT	MARGIN (%)	MEAS	LIMIT	MARGIN (%)
1	2.237	4.368	48.8	1.523	1.813	16.0
2	2.041	3.020	32.4	1.443	1.614	10.6
3	1.923	2.419	20.5	1.423	1.534	7.2
4	1.888	2.190	13.8	1.414	1.490	5.1

* The Technical Specification's limit for the heat flux hot channel factor, F-Q(T), is a function of core height. The value for F-Q(T) listed above is the maximum value of F-Q(T) in the core. The Technical Specification's limit listed above is evaluated at the plane of maximum F-Q(T). The minimum margin values listed above are the minimum percent difference between the measured values of F-Q(T) and the Technical Specification's limit for each map. The measured F-Q(T) hot channel factors include 8.15% total uncertainty.

Figure 6.1

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
ASSEMBLYWISE POWER DISTRIBUTION
28% POWER

R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
	PREDICTED MEASURED PCT DIFFERENCE					0.23 0.25 12.0	0.27 0.30 11.9	0.23 0.24 7.9				PREDICTED MEASURED PCT DIFFERENCE			1
				0.31 0.34 7.3	0.61 0.64 4.2	1.07 1.13 5.2	0.82 0.86 5.2	1.07 1.13 5.0	0.61 0.63 3.5	0.31 0.32 3.6					2
			0.34 0.35 2.8	1.16 1.19 2.3	1.33 1.34 0.9	1.24 1.27 2.3	1.32 1.35 2.1	1.24 1.26 1.5	1.33 1.35 1.8	1.16 1.19 2.5	0.34 0.35 3.7				3
		0.34 0.35 2.5	0.86 0.87 1.3	1.37 1.40 2.0	1.21 1.23 1.3	1.37 1.40 2.3	1.17 1.19 2.3	1.37 1.38 0.9	1.21 1.21 -0.2	1.37 1.36 -0.6	0.86 6.85 -0.9	0.34 0.34 0.3			4
	0.31 0.31 -1.9	1.16 1.14 -1.9	1.37 1.36 -1.0	1.18 1.17 -0.5	1.28 1.28 -0.5	1.20 1.23 2.4	1.11 1.14 2.5	1.20 1.21 1.3	1.28 1.28 -0.1	1.18 1.16 -1.5	1.37 1.32 -3.4	1.16 1.14 -1.4	0.31 0.32 3.0		5
	0.61 0.61 0.4	1.32 1.33 0.3	1.21 1.21 0.3	1.28 1.28 0.1	1.05 1.05 0.3	1.26 1.28 1.5	0.99 1.01 1.7	1.26 1.27 0.7	1.05 1.04 -0.4	1.28 1.25 -2.6	1.21 1.16 -3.7	1.32 1.30 -2.0	0.61 0.62 1.3		6
0.23 0.24 7.9	1.07 1.10 2.8	1.24 1.25 0.4	1.36 1.36 -0.4	1.18 1.17 -1.1	1.25 1.23 -1.2	1.14 1.16 1.6	1.25 1.28 1.7	1.14 1.14 -0.0	1.25 1.24 -0.9	1.18 1.16 -2.1	1.36 1.30 -4.3	1.24 1.22 -1.7	1.07 1.06 -0.6	0.23 0.23 0.8	7
0.27 0.29 7.8	0.82 0.84 2.9	1.32 1.32 0.1	1.16 1.16 0.2	1.09 1.09 0.2	0.95 0.95 0.2	1.25 1.25 -0.1	0.90 0.88 -1.6	1.25 1.23 -1.6	0.95 0.93 -1.6	1.09 1.05 -3.1	1.16 1.11 -4.2	1.32 1.29 -1.7	0.82 0.82 0.6	0.27 0.27 2.1	8
0.23 0.24 7.9	1.07 1.08 1.0	1.24 1.21 -2.5	1.36 1.35 -1.1	1.18 1.19 0.2	1.25 1.24 -0.8	1.14 1.11 -2.5	1.25 1.22 -2.4	1.14 1.12 -1.7	1.25 1.23 -1.7	1.18 1.17 -1.3	1.36 1.33 -2.4	1.24 1.23 -0.4	1.07 1.08 1.1	0.23 0.23 2.8	9
	0.61 0.59 -3.0	1.32 1.28 -3.0	1.21 1.20 -0.7	1.28 1.28 0.4	1.05 1.04 -1.0	1.26 1.25 -1.3	0.99 0.98 -1.0	1.26 1.25 -1.4	1.05 1.03 -1.5	1.28 1.26 -1.3	1.21 1.20 -0.6	1.32 1.32 -0.1	0.61 0.63 2.6		10
	0.31 0.31 0.1	1.16 1.16 0.1	1.37 1.37 0.2	1.18 1.18 0.4	1.28 1.26 -1.4	1.20 1.18 -1.3	1.11 1.10 -1.2	1.20 1.18 -1.3	1.28 1.26 -1.7	1.18 1.17 -0.8	1.37 1.38 0.7	1.16 1.17 1.0	0.31 0.32 2.2		11
		0.34 0.35 3.1	0.86 0.87 1.8	1.37 1.38 0.4	1.21 1.20 -0.9	1.37 1.36 -0.7	1.17 1.16 -0.6	1.37 1.35 -1.1	1.21 1.19 -1.6	1.37 1.36 -1.0	0.86 0.87 1.3	0.34 0.35 2.2			12
			0.34 0.35 3.1	1.16 1.16 0.4	1.33 1.30 -2.2	1.24 1.23 -1.2	1.32 1.31 -1.1	1.24 1.23 -0.9	1.33 1.30 -1.7	1.16 1.15 -0.6	0.34 0.34 2.0				13
				0.31 0.34 9.1	0.61 0.67 9.1	1.07 1.12 4.5	0.82 0.85 4.0	1.07 1.07 -0.9	0.61 0.60 -1.6	0.31 0.31 -1.7					14
	STANDARD DEVIATION =2.288					0.23 0.25 8.8	0.27 0.29 8.7	0.23 0.25 8.8				AVERAGE PCT DIFFERENCE = 2.2			15

SUMMARY

MAP NO: N2-8-01 DATE: 11/04/90 POWER: 28%

CONTROL ROD POSITIONS: Q(T) = 2.237 QPTR:

D BANK AT 150 STEPS F-DH(M) = 1.523

NW 1.011	NE 0.998
SW 0.999	SE 0.992

F(Z) = 1.372

BURNUP = 18 MWD/MTU A.O. = -3.264%

Figure 6.2

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
ASSEMBLYWISE POWER DISTRIBUTION
72% POWER

Legend (each cell): PREDICTED / MEASURED / PCT DIFFERENCE

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
		PREDICTED MEASURED PCT DIFFERENCE					0.25 0.27 4.4	0.31 0.32 4.3	0.25 0.26 3.5				PREDICTED MEASURED PCT DIFFERENCE			1
					0.32 0.34 3.2	0.63 0.66 4.7	1.10 1.14 2.9	0.90 0.93 2.9	1.10 1.13 2.1	0.63 0.64 2.5	0.32 0.33 2.1					2
				0.35 0.35 1.0	1.12 1.13 0.8	1.28 1.30 1.6	1.23 1.26 2.7	1.31 1.34 2.5	1.23 1.25 1.6	1.28 1.30 1.7	1.12 1.14 1.7	0.35 0.35 1.7				3
			0.35 0.35 0.9	0.85 0.85 0.7	1.31 1.33 1.1	1.18 1.20 1.9	1.33 1.36 2.6	1.15 1.18 2.6	1.33 1.35 1.4	1.18 1.18 0.4	1.31 1.31 -0.5	0.85 0.84 -1.0	0.35 0.34 -1.1			4
		0.32 0.32 -1.3	1.13 1.11 -1.3	1.31 1.31 -0.2	1.16 1.16 0.3	1.27 1.28 0.8	1.19 1.23 2.7	1.12 1.15 2.8	1.19 1.21 1.6	1.27 1.27 0.2	1.16 1.14 -1.0	1.31 1.28 -2.5	1.13 1.10 -2.4	0.32 0.32 -0.5		5
		0.63 0.63 0.6	1.28 1.29 0.6	1.18 1.19 0.8	1.27 1.28 1.0	1.12 1.14 1.5	1.28 1.31 2.1	1.02 1.04 2.2	1.28 1.29 0.8	1.12 1.11 -0.4	1.27 1.24 -1.8	1.18 1.15 -2.5	1.28 1.25 -2.3	0.63 0.62 -1.1		6
	0.25 0.26 1.9	1.10 1.11 0.9	1.23 1.23 0.5	1.32 1.32 0.1	1.18 1.18 -0.2	1.27 1.27 -0.3	1.17 1.19 2.0	1.27 1.29 2.1	1.17 1.17 0.3	1.27 1.26 -0.7	1.18 1.17 -1.3	1.32 1.28 -3.1	1.23 1.20 -2.1	1.10 1.08 -1.8	0.25 0.25 -1.1	7
	0.31 0.31 1.6	0.90 0.91 0.7	1.31 1.31 0.2	1.15 1.15 0.4	1.10 1.11 0.4	0.98 0.98 0.4	1.26 1.26 0.1	0.93 0.92 -0.8	1.26 1.24 -1.7	0.98 0.96 -1.6	1.10 1.08 -2.0	1.15 1.11 -3.1	1.31 1.28 -2.1	0.90 0.89 -1.5	0.31 0.31 -1.0	8
	0.25 0.26 1.9	1.10 1.09 -0.9	1.23 1.20 -2.3	1.32 1.31 -0.9	1.18 1.19 0.5	1.27 1.27 0.2	1.17 1.16 -0.2	1.27 1.27 -0.1	1.17 1.15 -1.8	1.27 1.25 -1.9	1.18 1.17 -1.2	1.32 1.30 -1.7	1.23 1.21 -1.0	1.10 1.09 -1.1	0.25 0.25 -0.4	9
		0.63 0.61 -2.9	1.28 1.24 -2.9	1.18 1.17 -0.5	1.27 1.28 0.8	1.12 1.12 0.2	1.28 1.29 0.3	1.02 1.02 0.4	1.28 1.27 -0.7	1.12 1.11 -0.9	1.27 1.26 -0.5	1.18 1.18 0.3	1.28 1.28 -0.2	0.63 0.63 -0.3		10
		0.32 0.32 -2.0	1.13 1.10 -2.0	1.31 1.30 -1.1	1.16 1.16 0.7	1.27 1.27 -0.0	1.19 1.20 0.1	1.12 1.12 0.2	1.19 1.20 0.3	1.27 1.27 0.2	1.16 1.16 0.3	1.31 1.32 0.6	1.13 1.13 0.3	0.32 0.33 0.3		11
			0.35 0.34 -1.0	0.85 0.85 -0.2	1.31 1.32 0.7	1.18 1.18 -0.0	1.33 1.33 -0.0	1.15 1.15 0.0	1.33 1.33 0.1	1.18 1.18 0.1	1.31 1.32 0.3	0.85 0.86 0.8	0.35 0.35 0.8			12
				0.35 0.34 -1.0	1.12 1.13 0.7	1.28 1.27 -0.7	1.23 1.22 -0.5	1.31 1.30 -0.3	1.23 1.23 -0.1	1.28 1.28 -0.1	1.12 1.13 0.3	0.35 0.35 0.8				13
					0.32 0.33 2.1	0.63 0.64 2.0	1.10 1.11 0.8	0.90 0.91 0.5	1.10 1.10 -0.1	0.63 0.63 -0.1	0.32 0.32 -0.1					14
		STANDARD DEVIATION =0.991					0.25 0.26 1.8	0.31 0.31 0.9	0.25 0.26 0.1				AVERAGE PCT DIFFERENCE = 1.2			15

SUMMARY

MAP NO: N2-8-02   DATE: 11/07/90   POWER: 72%

CONTROL ROD POSITIONS: F-Q(T) = 2.041   QPTR:

D BANK AT 185 STEPS   F-DH(M) = 1.443

QPTR	
NW 1.011	NE 0.997
SW 0.997	SE 0.995

F(Z) = 1.302

BURNUP = 63 MWD/MTU   A.O. = 1.045%

Figure 6.3

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
ASSEMBLYWISE POWER DISTRIBUTION
90% POWER

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A	
		PREDICTED MEASURED PCT DIFFERENCE					0.26 0.27 4.2	0.32 0.33 4.1	0.26 0.27 3.4				PREDICTED MEASURED PCT DIFFERENCE			1
					0.33 0.34 5	0.63 0.64 2.1	1.11 1.13 1.9	0.93 0.95 1.9	1.11 1.14 2.1	0.63 0.65 2.6	0.33 0.35 2.2					2
				0.35 0.35 1.5	1.11 1.12 1.1	1.27 1.27 -0.0	1.22 1.24 1.3	1.30 1.32 1.2	1.22 1.24 1.2	1.27 1.29 1.5	1.11 1.13 1.6	0.35 0.35 1.8				3
			0.35 0.35 1.5	0.84 0.85 0.7	1.30 1.31 1.2	1.17 1.18 1.3	1.32 1.34 1.9	1.15 1.17 1.9	1.32 1.33 0.7	1.17 1.17 0.3	1.30 1.29 -0.5	0.84 0.84 -0.6	0.35 0.35 -0.1			4
		0.33 0.32 -1.4	1.11 1.10 -1.4	1.30 1.29 -0.7	1.15 1.15 -0.3	1.27 1.28 0.6	1.20 1.23 3.0	1.12 1.16 2.9	1.20 1.21 1.4	1.27 1.27 0.2	1.15 1.14 -0.7	1.30 1.27 -1.9	1.11 1.10 -1.1	0.33 0.33 1.6		5
		0.63 0.63 0.0	1.27 1.27 -0.0	1.17 1.17 0.2	1.27 1.27 0.3	1.15 1.17 1.4	1.29 1.33 3.1	1.03 1.06 3.1	1.29 1.31 1.4	1.15 1.15 0.0	1.27 1.25 -1.6	1.17 1.14 -2.3	1.27 1.25 -1.7	0.63 0.63 0.0		6
	0.26 0.26 0.9	1.11 1.11 -0.2	1.22 1.21 -0.8	1.31 1.30 -0.8	1.19 1.18 -0.7	1.28 1.27 -0.7	1.17 1.21 2.8	1.27 1.31 2.8	1.17 1.18 0.9	1.28 1.28 -0.1	1.19 1.17 -1.2	1.31 1.27 -3.4	1.22 1.2[illegible] -2.2	1.11 1.09 -1.8	0.26 0.26 -1.0	7
	0.32 0.32 0.7	0.93 0.93 -0.4	1.30 1.29 -1.1	1.15 1.14 -0.2	1.10 1.11 0.5	0.99 0.99 0.5	1.27 1.27 0.0	0.93 0.93 -0.1	1.27 1.26 -0.8	0.99 0.98 -0.8	1.10 1.09 -1.6	1.15 1.11 -3.6	1.30 1.27 -2.2	0.93 0.92 -1.4	0.32 0.32 -0.6	8
	0.26 0.26 0.9	1.11 1.09 -1.8	1.22 1.18 -3.2	1.31 1.29 -1.3	1.19 1.19 0.6	1.28 1.28 0.3	1.17 1.17 -0.3	1.27 1.27 -0.3	1.17 1.16 -0.9	1.28 1.27 -1.0	1.19 1.18 -0.5	1.31 1.29 -1.6	1.22 1.21 -0.8	1.11 1.10 -0.7	0.26 0.26 0.2	9
		0.63 0.61 -3.2	1.27 1.23 -3.2	1.17 1.16 -0.4	1.27 1.28 1.0	1.15 1.16 0.5	1.29 1.30 0.4	1.03 1.03 0.6	1.29 1.28 -0.6	1.15 1.14 -0.6	1.27 1.27 -0.2	1.17 1.18 0.9	1.27 1.27 0.4	0.63 0.63 0.6		10
		0.33 0.32 -1.7	1.11 1.09 -1.7	1.30 1.29 -0.8	1.15 1.16 1.0	1.27 1.27 -0.1	1.20 1.20 0.0	1.12 1.12 0.2	1.20 1.20 -0.0	1.27 1.27 0.1	1.15 1.15 0.2	1.30 1.31 0.9	1.11 1.12 0.6	0.33 0.33 1.1		11
			0.35 0.35 -0.1	0.84 0.85 0.4	1.30 1.31 0.9	1.17 1.17 -0.1	1.32 1.31 -0.5	1.15 1.14 -0.5	1.32 1.31 -0.7	1.17 1.17 -0.3	1.30 1.29 -0.2	0.84 0.85 1.0	0.35 0.35 0.8			12
				0.35 0.35 -0.1	1.11 1.12 0.9	1.27 1.26 -1.1	1.22 1.21 -1.4	1.30 1.29 -0.8	1.22 1.22 -0.7	1.27 1.27 -0.3	1.11 1.11 -0.6	0.35 0.35 [illegible]				13
					0.33 0.33 2.2	0.63 0.64 2.2	1.11 1.11 0.2	0.93 0.93 0.2	1.11 1.11 -0.6	0.63 0.63 -0.2	0.33 0.32 -1.1					14
		STANDARD DEVIATION =0.967					0.26 0.27 2.0	0.32 0.32 1.3	0.26 0.26 0.7				AVERAGE PCT DIFFERENCE = 1.1			15

SUMMARY

MAP NO: N2-8-03 DATE: 11/08/90 POWER: 90%

CONTROL ROD POSITIONS: F-Q(T) = 1.923 QPTR:

D BANK AT 204 STEPS F-DH(N) = 1.423

NW 1.008	NE 0.999
SW 0.997	SE 0.997

F(Z) = 1.237

BURNUP = 88 MWD/MTU A.O. = 0.162%

Figure 6.4

NORTH ANNA UNIT 2 - CYCLE 8 STARTUP PHYSICS TESTS
ASSEMBLYWISE POWER DISTRIBUTION
100% POWER

PREDICTED / MEASURED / PCT DIFFERENCE

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							0.27 0.28 4.7	0.33 0.34 4.7	0.27 0.28 3.8						
2					0.33 0.34 4.6	0.63 0.65 2.5	1.11 1.13 1.8	0.95 0.96 1.0	1.11 [illegible] [illegible]	0.63 0.65 2.8	0.33 0.34 2.9				
3				0.35 0.35 1.3	1.10 1.11 0.9	1.26 1.26 -0.0	1.22 1.24 1.4	1.30 1.32 1.2	1.22 1.24 1.3	1.26 1.28 1.9	1.10 1.13 2.3	0.35 0.36 3.0			
4			0.35 0.35 0.9	0.84 0.84 0.3	1.29 1.30 0.9	1.16 1.18 1.0	1.31 1.33 1.8	1.15 1.17 1.8	1.31 1.32 0.9	1.16 1.17 0.9	1.29 1.29 0.2	0.84 0.84 -0.2	0.35 0.35 0.3		
5		0.33 0.32 -2.5	1.10 1.08 -2.5	1.29 1.28 -1.1	1.15 1.14 -0.6	1.27 1.28 0.2	1.20 1.23 3.1	1.12 1.16 3.1	1.20 1.22 2.2	1.27 1.29 1.0	1.15 1.14 -0.3	1.29 1.26 -1.9	1.10 1.09 -1.3	0.33 0.33 2.1	
6		0.63 0.62 -1.0	1.26 1.25 -1.0	1.16 1.16 -0.4	1.27 1.27 0.2	1.17 1.18 1.1	1.30 1.34 2.5	1.03 1.07 3.0	1.30 1.33 2.1	1.17 1.18 1.4	1.27 1.26 -1.3	1.16 1.14 -2.2	1.26 1.24 -1.9	0.63 0.63 -0.1	
7	0.27 0.27 2.7	1.11 1.11 -0.1	1.22 1.20 -1.4	1.31 1.29 -1.9	1.19 1.18 -0.4	1.29 1.28 -0.4	1.18 1.22 3.1	1.28 1.32 3.1	1.18 1.20 1.9	1.29 1.31 1.4	1.19 1.19 -0.2	1.31 1.26 -3.4	1.22 1.19 -2.4	1.11 1.09 -2.1	0.27 0.26 -1.4
8	0.35 0.34 2.7	0.95 0.94 -0.2	1.30 1.28 -1.7	1.14 1.14 -0.5	1.11 1.11 0.6	0.99 1.00 0.6	1.27 1.28 0.4	0.96 0.95 1.6	1.27 1.27 -0.1	0.99 0.99 0.0	1.11 1.09 -1.1	1.14 1.10 -3.4	1.30 1.27 -2.4	0.95 0.93 -1.2	0.33 0.33 -0.3
9	0.27 0.27 2.7	1.11 1.09 -1.6	1.22 1.17 -3.7	1.31 1.29 -1.5	1.19 1.19 0.6	1.26 1.29 0.2	1.18 1.17 -0.6	1.28 1.27 -0.6	1.18 1.18 -0.2	1.29 1.29 -0.3	1.19 1.19 -0.0	1.31 1.20 -1.7	1.22 1.21 -0.7	1.11 1.11 -0.3	0.27 0.27 0.9
10		0.63 0.61 -3.7	1.26 1.21 -3.7	1.16 1.15 -0.7	1.27 1.28 0.9	1.17 1.18 0.4	1.30 1.30 0.3	1.03 1.04 0.4	1.30 1.29 -0.7	1.17 1.16 -0.7	1.27 1.27 -0.4	1.16 1.12 0.8	1.26 1.27 0.7	0.63 0.64 1.5	
11		0.33 0.32 -1.2	1.10 1.09 -1.2	1.29 1.28 -0.4	1.15 1.16 1.1	1.27 1.27 -0.4	1.20 1.19 -0.4	1.12 1.12 -0.2	1.20 1.20 -0.1	1.27 1.27 -0.7	1.15 1.15 0.2	1.29 1.30 1.1	1.10 1.12 1.1	0.33 0.33 1.8	
12			0.35 0.35 1.3	0.84 0.85 1.2	1.29 1.30 1.1	1.16 1.16 -0.5	1.31 1.30 -1.0	1.15 1.14 -0.9	1.31 1.30 -1.1	1.16 1.15 -0.7	1.29 1.28 -0.4	0.84 0.85 1.3	0.35 0.35 1.4		
13				0.35 0.35 1.3	1.10 1.11 1.1	1.26 1.24 -1.9	1.22 1.19 -2.0	1.30 1.28 -1.6	1.22 1.20 -1.6	1.26 1.24 -1.4	1.10 1.09 -0.9	0.35 0.35 1.3			
14					0.33 0.34 3.6	0.63 0.65 3.6	1.11 1.12 0.8	0.95 0.95 0.2	1.11 1.10 -1.5	0.63 0.62 -1.3	0.33 0.32 -2.0				
15							0.27 0.28 3.6	0.33 0.33 1.5	0.27 0.26 -0.7						

STANDARD DEVIATION =1.074

AVERAGE PCT DIFFERENCE = 1.4

SUMMARY

MAP NO: N2-8-04 DATE: 11/14/90 POWER: 100%

CONTROL ROD POSITIONS: F-Q(T) = 1.888 QPTR:

D BANK AT 228 STEPS F-DH(N) = 1.414

QPTR	
NW 1.006	NE 1.002
SW 0.996	SE 0.996

F(Z) = 1.202

BURNUP = 315 MWD/MTU A.O. = -1.361%

SECTION 7

REFERENCES

1. T. S. Psuik and P. D. Banning, "North Anna Unit 2, Cycle 8 Design Report," Technical Report NE-803, Revision 0, Virginia Power, October, 1990

2. T. K. Ross, W. C. Beck, "Control Rod Reactivity Worth Determination By The Rod Swap Technique," VEP-FRD-36A, December, 1980.

3. W. Leggett and L. Eisenhart, "The INCORE Code," WCAP-7149, December, 1967.

4. North Anna Unit 2 Technical Specifications, Sections 1.18, 3.1.3.4, 3.2.2, 3.2.3, 3.1.1.4 and 4.1.1.1.2.

APPENDIX

STARTUP PHYSICS TESTS RESULTS
AND EVALUATION SHEETS

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Reactivity Computer Checkout Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: *	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD:	RCS Temperature (°F): 546.1 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
	Date/Time Test Performed: 11/1/90 18:31	
IV	Measured Parameter (Description)	ρ_c = Meas. Reactivity from ρ-computer ρ_t = Predicted Reactivity
Test Results	Measured Value	ρ_c = −50.0 +55.0 ρ_t = −51.0 +55.6 %D = −2.0% −1.1%
	Design Value (Actual Conditions)	$\%D = ((\rho_c - \rho_t)/\rho_t) \times 100\% \leq 4.0\%$
	Design Value (Design Conditions)	$\%D = ((\rho_c - \rho_t)/\rho_t) \times 100\% \leq 4.0\%$
	Reference	WCAP 7905, Rev. 1, Table 3.6
V Acceptance Criteria	FSAR/Tech Spec	Not Applicable
	Reference	Not Applicable
VI Comments	Design Tolerance is met : X YES __ NO Acceptance Criteria is met : X YES __ NO	
	* At The Just Critical Position Allowable Range = +55, −50 pcm	

Prepared By: [signature] Reviewed By: Thomas S Prink

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET
(PRELIMINARY ANALYSIS)

I Reference	Test Description: Critical Boron Concentration - ARO Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 223 CA: 228 CB: 228 CC: 228 CD: 228	RCS Temperature (°F): 546.2 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
	Date/Time Test Performed: 11/1/90 21:10	

IV	Meas Parameter (Description)	$(C_B)^M_{ARO}$; Critical Boron Conc - ARO
Test Results	Measured Value	$(C_B)^M_{ARO}$ = 2073 ppm
	Design Value (Actual Cond)	C_B = 2063 ± 50 ppm
	Design Value (Design Cond)	C_B = 2063 ± 50 ppm
	Reference	Technical Report NE-803 Rev. 0
V Acceptance Criteria	FSAR/Tech Spec	$\alpha C_B \times C_B^D \leq 1000$ pcm
	Reference	Technical Specification 4.1.1.1.2
	Design Tolerance is met : ✓ YES ___NO Acceptance Criteria is met : ✓ YES ___NO	
VI Comments	αC_B = -6.94 pcm/ppm for preliminary analysis $C_B^D = \lvert (C_B)^M_{ARO} - C_B \rvert$; C_B is design value at actual conditions.	

Prepared By: [signature] Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET
(FINAL ANALYSIS)

I Reference	Test Description: Critical Boron Concentration - ARO Proc No /Section: 2-PT-94.0		Sequence Step No:
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228		RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228		RCS Temperature (°F): 546.2 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 11/1/90 2110		
	Meas Parameter (Description)	$(C_B)^M_{ARO}$; Critical Boron Conc - ARO	
	Measured Value	$(C_B)^M_{ARO}$ = 2073 ppm	
	Design Value (Actual Cond)	C_B = 2063 ± 50 ppm	
	Design Value (Design Cond)	C_B =2063 ± 50 ppm	
	Reference	Technical Report NE-803 Rev. 0	
V Acceptance Criteria	FSAR/Tech Spec	$\alpha C_B \times C_B^D \leq 1000$ pcm	
	Reference	Technical Specification 4.1.1.1.2	
VI Comments	Design Tolerance is met : ✓ YES ___NO Acceptance Criteria is met : ✓ YES ___NO		
	αC_B = -7.04 pcm/ppm $C_B^D = \lvert (C_B)^M_{ARO} - C_B \rvert$; C_B is design value at actual conditions.		

Prepared By: Pamela D Banning Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Isothermal Temperature Coefficient - ARO Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: 228	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 228 CC: 228 CD: Date/Time Test Performed: 11/1/90 2154	RCS Temperature (°F): 544.9 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
IV	Meas Parameter (Description)	$(\alpha_T^{ISO})_{ARO}$ Isothermal Temp Coeff - ARO
Test Results	Measured Value	$(\alpha_T^{ISO})_{ARO}$ = -1.37 pcm/°F (C_B = 2083 ppm)
	Design Value (Actual Cond)	$(\alpha_T^{ISO})_{ARO}$ = -0.50 pcm/°F (C_B = 2083 ppm)
	Design Value (Design Cond)	$(\alpha_T^{ISO})_{ARO}$ = -0.69 ± 3.0 pcm/°F (C_B = 2063 ppm)
	Reference	Technical Report NE-803 Rev. 0
V Acceptance Criteria	FSAR/Tech Spec	$\alpha_T^{ISO} \le 3.75^*$ pcm/°F α_T^{Dop} = -1.75 pcm/°F ISO
	Reference	TS 3.1.1.4, Technical Report NE-803 Rev. 0
VI	Design Tolerance is met : ✓ YES ___ NO Acceptance Criteria is met : ✓ YES ___ NO	
Comments	* Uncertainty on αT_{MOD} = 0.5 pcm/°F (Reference: memorandum from C. T. Snow to E. J. Lozito dated June 27, 1980).	

NOTE: TEST USED TWO COOLDOWNS.

Prepared By: Pamela D. Banning Reviewed By: [illegible]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Cntl Bank B Worth Meas.,Rod Swap Ref. Bank Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC: 228 CD: 228	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC: 228 CD: 228	RCS Temperature (°F): 543.8 ✓ Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 11/2/90 0005	
	Measured Parameter (Description)	I_B^{REF} ; Integral Worth of Cntl Bank B, All Other Rods Out
	Measured Value	I_B^{REF} = 1259.9 pcm ✓
	Design Value (Actual Conditions)	I_B^{REF} = 1264±126 pcm ✓
	Design Value (Design Conditions)	I_B^{REF} = 1264 ± 126 pcm
	Reference	Te-hnical Report NE-803 Rev. 0
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : ✓ YES ___NO Acceptance Criteria is met : ✓ YES ___NO	

Prepared By: Pamela D. Banning Reviewed By: Andrew H. Nichols

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET
(PRELIMINARY ANALYSIS)

I Reference	Test Description: Critical Boron Concentration - B Bank In Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 0 CC: 228 CD: 228	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 0 CC: 228 CD: 228	RCS Temperature (°F): 546.3 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
	Date/Time Test Performed: 11/2/90 0345	
IV	Meas Parameter (Description)	$(C_B)^M_B$; Critical Boron Conc - B Bank In
Test Results	Measured Value	$(C_B)^M_B$ = 1894 ✓
	Design Value (Actual Cond)	C_B = 1890 ± 28 ppm ✓
	Design Value (Design Cond)	$C_B = 1880 + \Delta C_B^{Prev} \pm (10 + 126.4/\lvert\alpha C_B\rvert)$ppm
	Reference	Technical Report NE-803 Rev. 0
V Acceptance Criteria	FSAR/Tech Spec	$\alpha C_B \times C_B^D \leq 1000$ pcm
	Reference	Technical Specification 4.1.1.1.2
VI Comments	Design Tolerance is met : ✓ YES ___ NO Acceptance Criteria is met : ✓ YES ___ NO	
	αC_B = -6.94 pcm/ppm for preliminary analysis $\Delta C_B^{Prev} = (C_B)^M_{ARO} - 2063$ $C_B^D = \lvert(C_B)^M_B - C_B\rvert$; C_B is design value at actual conditions.	

Prepared By: Pamela P. Banning Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET
(FIANL ANALYSIS)

I Reference	Test Description: Critical Boron Concentration - B Bank In Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 0 CC: 228 CD: 228	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB: 0 CC: 228 CD: 228	RCS Temperature (°F): 546.3 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
	Date/Time Test Performed: 11/2/90 0345	
IV Test Results	Meas Parameter (Description)	$(C_B)^M_B$; Critical Boron Conc - B Bank In
	Measured Value	$(C_B)^M_B$ = 1894 ppm
	Design Value (Actual Cond)	C_B = 1890 ± 28 ppm
	Design Value (Design Cond)	$C_B = 1880 + \Delta C_B^{Prev} \pm (10 + 126.4/\lvert\alpha C_B\rvert)$ppm
	Reference	Technical Report NE-803 Rev. 0
V Acceptance Criteria	FSAR/Tech Spec	$\alpha C_B \times C_B^D \leq 1000$ pcm
	Reference	Technical Specification 4.1.1.1.2
VI Comments	Design Tolerance is met : ✓ YES ___ NO Acceptance Criteria is met : ✓ YES ___ NO	
	αC_B = -7.04 pcm/ppm $\Delta C_B^{Prev} = (C_B)^M_{ARO} - 2063$ $C_B^D = \lvert(C_B)^M_B - C_B\rvert$; C_B is design value at actual conditions.	

Prepared By: Pamela D. Banning Reviewed By: Andrew A. Nicholson

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET
(PRELIMINARY ANALYSIS)

I Reference	Test Description: HZP Boron Worth Coefficent Measurement Proc No /Section: 2-PT-94.0 Sequence Step No:		
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC: 228 CD: 228		RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC: 228 CD: 228		RCS Temperature (°F): 546.2 ✓ Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
	Date/Time Test Performed: 11/1/90 2110 ✓		
IV	Measured Parameter (Description)	αC_B, Boron Worth Coefficient	
Test Results	Measured Value	αC_B = −7.04 pcm/ppm	
	Design Value (Actual Conditions)	$\alpha C_B = -6.94 \pm 0.69$ pcm/ppm	
	Design Value (Design Conditions)	$\alpha C_B = -6.94 \pm 0.69$ pcm/ppm	
	Reference	Technical Report NE-803 Rev. 0	
V Acceptance Criteria	FSAR/Tech Spec	Not Applicable	
	Reference	Not Applicable	
VI Comments	Design Tolerance is met : ✓ YES __ NO Acceptance Criteria is met : ✓ YES __ NO		

Prepared By: Pamela D. Banning Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET
(FINAL ANALYSIS)

I Reference	Test Description: HZP Boron Worth Coefficent Measurement Proc No /Section: 2-PT-94.0 Sequence Step No:		
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC: 228 CD: 228		RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC: 228 CD: 228		RCS Temperature (°F): 546.2 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
	Date/Time Test Performed: 11/1/90 2110		
IV	Measured Parameter (Description)	αC_B, Boron Worth Coefficient	
Test Results	Measured Value	αC_B = -7.04 pcm/ppm	
	Design Value (Actual Conditions)	αC_B = -6.94 ± 0.69 pcm/ppm	
	Design Value (Design Conditions)	αC_B = -6.94 ± 0.69 pcm/ppm	
	Reference	Technical Report NE-803 Rev. 0	
V Acceptance Criteria	FSAR/Tech Spec	Not Applicable	
	Reference	Not Applicable	
VI Comments	Design Tolerance is met : ✓ YES __NO Acceptance Criteria is met : ✓ YES __NO		

Prepared By: Pamela D. Banning   Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Cntl Bank D Worth Measurement-Rod Swap Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC: 228 CD:Moving	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC: 228 CD:Moving	RCS Temperature (°F): 546.3 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 11/2/90 0456	
	Meas Parameter (Description)	I_D^{RS} ; Int Worth of Cntl Bank D-Rod Swap
	Measured Value	I_D^{RS} = 1025.7 (Adj. Meas. Crit. Ref Bank Position = 166.9 steps)
	Design Value (Actual Cond)	I_D^{RS} = 999 ± 150 (Adj. Meas. Crit. Ref Bank Position = 166.9 steps)
	Design Value (Design Cond)	I_D^{RS} = 1001 ± 150 pcm (Critical Ref Bank Position = 163 steps)
	Reference	Technical Report NE-803 Rev. 0, VEP-FRD-36A
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : ✓ YES ___NO Acceptance Criteria is met : ✓ YES ___NO	

Prepared By: Pamela D. Banning Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Cntl Bank C Worth Measurement-Rod Swap Proc No /Section: 2-PT-94.0 Sequence Step No:		
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC:Moving CD: 228		RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB:Moving CC:Moving CD: 228		RCS Temperature (°F): ~~543.6~~ 546.3 [initials] 11/2/90 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 6:57 11/2/90		
	Meas Parameter (Description)	I_C^{RS} ; Int Worth of Cntl Bank C-Rod Swap	
	Measured Value	I_C^{RS} = 710.3 (Adj. Meas. Crit. Ref Bank Position = 120.2 steps)	
	Design Value (Actual Cond)	I_C^{RS} = 739.8 ± 111 (Adj. Meas. Crit. Ref Bank Position = 120.2 steps)	
	Design Value (Design Cond)	I_C^{RS} = 738 ± 111 pcm (Critical Ref Bank Position = 125 steps)	
	Reference	Technical Report NE-803 Rev. 0, VEP-FRD-36A	
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.	
	Reference	VEP-FRD-36A	
VI Comments	Design Tolerance is met : X YES __NO Acceptance Criteria is met : X YES __NO		

Prepared By: [signature] Reviewed By: Thomas S Pai[signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Cntl Bank A Worth Measurement-Rod Swap Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA:Moving CB:Moving CC: 228 CD: 228	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA:Moving CB:Moving CC: 228 CD: 228	RCS Temperature (°F): 546.4 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 7:52 11/12/90	
	Meas Parameter (Description)	I_A^{RS} ; Int Worth of Cntl Bank A - Rod Swap
	Measured Value	I_A^{RS} = 330.5 (Adj. Meas. Crit. Ref Bank Position = 77.9 steps)
	Design Value (Actual Cond)	I_A^{RS} = 307.7 ± 100 pcm (Adj. Meas. Crit. Ref Bank Position = 77.9 steps)
	Design Value (Design Cond)	I_A^{RS} = 309 ± 100 pcm (Critical Ref Bank Position = 78 steps)
	Reference	Technical Report NE-803 Rev. 0, VEP-FRD-36A
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : X YES __NO Acceptance Criteria is met : X YES __NO	

Prepared By: Thomas S Prush Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Shutdown Bank B Worth Meas. - Rod Swap Proc No /Section: 2-PT-94.0 Sequence Step No:		
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB:Moving CA: 228 CB:Moving CC: 228 CD: 228		RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB:Moving CA: 228 CB:Moving CC: 228 CD: 228		RCS Temperature (°F): 546.3 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
IV Test Results	Date/Time Test Performed: 8:15 11/2/90		
	Meas Parameter (Description)	I_{SB}^{RS}; Int Worth of Shutdown Bank B-Rod Swap	
	Measured Value	I_{SB}^{RS} = 976.6 (Adj. Meas. Crit. Ref Bank Position = 158.7 steps)	
	Design Value (Actual Cond)	I_{SB}^{RS} = 996.4 ± 149 (Adj. Meas. Crit. Ref Bank Position = 158.7 steps)	
	Design Value (Design Cond)	I_{SB}^{RS} = 995 ± 149 pcm (Critical Ref Bank Position = 162 steps)	
	Reference	Technical Report NE-803 Rev. 0, VEP-FRD-36A	
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.	
	Reference	VEP-FRD-36A	
VI Comments	Design Tolerance is met : X YES __ NO Acceptance Criteria is met : X YES __ NO		

Prepared By: Thomas S Prim Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Shutdown Bank A Worth Meas. - Rod Swap Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA:Moving SDB: 228 CA: 228 CB:Moving CC: 228 CD: 228	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA:Moving SDB: 228 CA: 228 CB:Moving CC: 228 CD: 228	RCS Temperature (°F): 546.2 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
	Date/Time Test Performed: 9:09 11/2/90	

IV Test Results	Meas Parameter (Description)	I_{SA}^{RS}, Int Worth of Shutdown Bank A-Rod Swap
	Measured Value	I_{SA}^{RS} = 1061.7 (Adj. Meas. Crit. Ref Bank Position = 173.5 steps)
	Design Value (Actual Cond)	I_{SA}^{RS} = 1014.1 ± 152 (Adj. Meas. Crit. Ref Bank Position = 173.5 steps)
	Design Value (Design Cond)	I_{SA}^{RS} = 1013 ± 152 pcm (Critical Ref Bank Position = 165 steps)
	Reference	Technical Report NE-803 Rev. 0, VEP-FRD-36A
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : X YES ___NO Acceptance Criteria is met : X YES ___NO	

Prepared By: [signature] Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: Total Rod Worth - Rod Swap Proc No /Section: 2-PT-94.0 Sequence Step No:	
II Test Conditions (Design)	Bank Positions (Steps) SDA:Moving SDB:Moving CA:Moving CB:Moving CC:Moving CD:Moving	RCS Temperature (°F): 547 Power Level (% F.P.): 0 Other (specify): Below Nuclear Heating
III Test Conditions (Actual)	Bank Positions (Steps) SDA:Moving SDB:Moving CA:Moving CB:Moving CC:Moving CD:Moving	RCS Temperature (°F): 543.8 Power Level (% F.P.): 0 Other (Specify): Below Nuclear Heating
	Date/Time Test Performed: 0005 11/2/90	

IV Test Results	Meas Parameter (Description)	I_{Total}: Int Worth of All Banks - Rod Swap
	Measured Value	I_{Total} = 5364.7
	Design Value (Actual Cond)	I_{Total} = 5321.0 ± 532
	Design Value (Design Cond)	I_{Total} = 5320 ± 532 pcm
	Reference	Technical Report NE-803 Rev. 0, VEP-FRD-36A
V Acceptance Criteria	FSAR/Tech Spec	If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.
	Reference	VEP-FRD-36A
VI Comments	Design Tolerance is met : X YES __NO Acceptance Criteria is met : X YES __NO	

Prepared By: [signature] Reviewed By: Thomas 8 Pink

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map - At power Proc No /Section: 2-PT-21.1	Sequence Step No: 41
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: *	RCS Temperature ($^{\circ}$F): T_{REF} ±1 Power Level (% F.P.): <30% Other (specify) Must have ≥ 38 thimbles
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 150	RCS Temperature($^{\circ}$F): 550° Power Level (% F.P.): 27.71% Other (Specify): RCS Boron = 1743 ppm
	Date/Time Test Performed: 11/4/90 1530	17.57 MWD/MTU 0.44 EFPD 43 THIMBLES

IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	5.2%, P>.9 12.0%, P<.9	1.523	2.243	1.013
	Design Value (Design Conds)	± 10% for P_i ≥ 0.9 ± 15% for P_i < 0.9 (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^{N}_{\Delta H} \leq 1.49(1+.3(1-P))$	$F^{T}_{Q}(Z) \leq 4.38 \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments	Design Tolerance is met : X YES __NO Acceptance Criteria is met : X YES __NO
	* As Required

Prepared By: R8McCandrew Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map-At Power Proc No / Section: 2-PT-21.1 Sequence Step No: 43	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: *	RCS Temperature ($^{\circ}$F): T_{REF} ±1 Power Level (% F.P.): <75% Other (specify) Must have ≥ 38 thimbles
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 185	RCS Temperature($^{\circ}$F): Power Level (% F.P.): 72.15% Other (Specify): 62.8 MWD/MTU 1.6 EFPD 46 THIMBLES
	Date/Time Test Performed: 11/7/90	

		MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
IV	Meas Parameter (Description)				
Test Results	Measured Value	3.1%, P>.9 4.7%, P<.9	1.443	1.888	1.0117
	Design Value (Design Conds)	± 10% for $P_i \ge 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_H \le 1.49(1+.3(1-P))$	$F^T_Q(Z) \le 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments

Design Tolerance is met : X YES ___NO
Acceptance Criteria is met : X YES ___NO

* As Required

Prepared By: R S McCandrew Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map- NI Calibration Proc No / Section: 2-PT-~~22.2~~ 21.1 RPM 12-19-90			Sequence Step No: ~~44~~ 43 RPM 11-19-90	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: **			RCS Temperature (°F): T_{REF} ±1 Power Level (% F.P.): 95±5 Other (specify): *	
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 204			RCS Temperature(°F): Power Level (% F.P.): 90.07% Other (Specify): 87.7 MWD/MTU 2.2 EFPD 46 THIMBLES	
	Date/Time Test Performed: 11/8/90 1830				
IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	-3.4%, P≥.9 4.5%, P<.9	1.423	1.778	1.0092
	Design Value (Design Conds)	± 10% for P_i ≥ 0.9 ± 15% for P_i < 0.9 (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_{\Delta H} \leq 1.49(1+.3(1-P))$	$F^T_Q(Z) \leq 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	Design Tolerance is met : X YES ___NO Acceptance Criteria is met : X YES ___NO				
	* Must have at least 38 thimbles for a full-core flux map, or at least 16 thimbles for a quarter-core flux map. ** As Required				

Prepared By: RDMcAndrew

Reviewed By: HMin

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map - HFP, ARO, Eq. Xe Proc No / Section: 2-PT-21.1 Sequence Step No: 45				
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: *		RCS Temperature (°F): T_{REF} ±1 Power Level (% F.P.): 95±5 Other (specify): Eq. Xe. Must have ≥ 38 thimbles		
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 228		RCS Temperature(°F): Power Level (% F.P.): 99.98% Other (Specify): 315.2 MWD/MTU 7.9 EFPD 1404 ppm 46 THIMBLES		
	Date/Time Test Performed: 11-14-90 1400				
IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	3.7%, P ≥ .9 4.7%, P < .9	1.414	1.746	1.0086
	Design Value (Design Conds)	≤ 10% for P_i ≥ 0.9 ≤ 15% for P_i < 0.9 (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_H \le 1.49(1+.3(1-P))$	$F^T_Q(Z) \le 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	Design Tolerance is met : X YES __NO Acceptance Criteria is met : X YES __NO				
	* As Required				

Prepared By: [signature]   Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map- NI Calibration Proc No / Section: 2-PT-22.2 Sequence Step No: 46				
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: **			RCS Temperature (°F): T_{REF} ±1 Power Level (% F.P.): 95±5 Other (specify): *	
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 205			RCS Temperature(°F): Power Level (% F.P.): 99.87% Other (Specify): 341.1 MWD/MTU 8.57 EFPD 26 THIMBLES / 1/4 CORE MAP	
	Date/Time Test: 11-15-90 Performed: 0600				
IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	*NA	NA	NA	NA
	Design Value (Design Conds)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_{\Delta H} \leq 1.49(1+.3(1-P))$	$F^T_Q(Z) \leq 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	Design Tolerance is met : X YES __NO Acceptance Criteria is met : X YES __NO				
	* Must have at least 38 thimbles for a full-core flux map, or at least 16 thimbles for a quarter-core flux map. ** As Required				

Prepared By: RSMcAndrew Reviewed By: [signature]

* NA because this is a 1/4 core map.

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference
Test Description: M/D Flux Map- NI Calibration
Proc No / Section: 2-PT-22.2 Sequence Step No: 47

II Test Conditions (Design)
Bank Positions (Steps)
SDA: 228 SDB: 228 CA: 228
CB : 228 CC : 228 CD: **
RCS Temperature (°F): T_{REF} ±1
Power Level (% F.P.): 95±5
Other (specify): *

III Test Conditions (Actual)
Bank Positions (Steps)
SDA: 228 SDB: 228 CA: 228
CB : 228 CC : 228 CD: 228
RCS Temperature(°F):
Power Level (% F.P.): 100.1%
Other (Specify):
358.5 MWD/MTU
9.01 EFPD
26 THIMBLES / 1/4 CORE MAP
Date/Time Test Performed: 11-15-90 1700

IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	NA#	NA	NA	NA
	Design Value (Design Conds)	≤ 10% for $P_i \geq 0.9$; ≤ 15% for $P_i < 0.9$ (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_{\Delta H} \le 1.49(1+0.3(1-P))$	$F^T_Q(Z) \le 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments
Design Tolerance is met : X YES __NO
Acceptance Criteria is met : X YES __NO

* Must have at least 38 thimbles for a full-core flux map, or at least 16 thimbles for a quarter-core flux map.
** As Required

Prepared By: [signature] Reviewed By: [signature]

NA because this is a 1/4 core map

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

<table>
<tr><td>I
Reference</td><td colspan="2">Test Description: Total Rod Worth - Rod Swap
Proc No /Section: 2-PT-94.0 Sequence Step No:</td></tr>
<tr><td rowspan="2">II
Test
Conditions
(Design)</td><td>Bank Positions (Steps)</td><td rowspan="2">RCS Temperature (°F): 547
Power Level (% F.P.): 0
Other (specify):
Below Nuclear Heating</td></tr>
<tr><td>SDA:Moving SDB:Moving CA:Moving
CB:Moving CC:Moving CD:Moving</td></tr>
<tr><td rowspan="2">III
Test
Conditions
(Actual)</td><td>Bank Positions (Steps)</td><td rowspan="2">RCS Temperature (°F): 543.8
Power Level (% F.P.): 0
Other (Specify):
Below Nuclear Heating</td></tr>
<tr><td>SDA:Moving SDB:Moving CA:Moving
CB:Moving CC:Moving CD:Moving</td></tr>
<tr><td rowspan="6">IV
Test
Results</td><td colspan="2">Date/Time Test Performed:
0005 11/2/90</td></tr>
<tr><td>Meas Parameter
(Description)</td><td>I_{Total}; Int Worth of All Banks - Rod Swap</td></tr>
<tr><td>Measured Value</td><td>I_{Total} = 5364.7</td></tr>
<tr><td>Design Value
(Actual Cond)</td><td>I_{Total} = 5321.0 ± 532</td></tr>
<tr><td>Design Value
(Design Cond)</td><td>I_{Total} = 5320 ± 532 pcm</td></tr>
<tr><td>Reference</td><td>Technical Report NE-803 Rev. 0, VEP-FRD-36A</td></tr>
<tr><td rowspan="2">V
Acceptance
Criteria</td><td>FSAR/Tech Spec</td><td>If Design Tolerance is exceeded, SNSOC shall evaluate impact of test result on safety analysis. SNSOC may specify that additional testing be performed.</td></tr>
<tr><td>Reference</td><td>VEP-FRD-36A</td></tr>
<tr><td rowspan="2">VI
Comments</td><td colspan="2">Design Tolerance is met : X YES __NO
Acceptance Criteria is met : X YES __NO</td></tr>
<tr><td colspan="2"></td></tr>
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Prepared By: [signature] Reviewed By: Thomas S Paik

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map - At power Proc No /Section: 2-PT-21.1			Sequence Step No: 41	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: *		RCS Temperature (°F): T_{REF} ±1 Power Level (% F.P.): <30% Other (specify) Must have ≥ 38 thimbles		
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 150		RCS Temperature(°F): 550° Power Level (% F.P.): 27.71% Other (Specify): RCS Boron = 1743 ppm 17.57 MWD/MTU 0.44 EFPD 43 THIMBLES		
	Date/Time Test Performed: 11/4/90 1530				
IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	5.2%, P>.9 12.0%, P<.9	1.523	2.243	1.013
	Design Value (Design Conds)	± 10% for $P_i \ge 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_{\Delta H} \le 1.49(1+.3(1-P))$	$F^T_Q(Z) \le 4.38 \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4
VI Comments	Design Tolerance is met : X YES __NO Acceptance Criteria is met : X YES __NO * As Required				

Prepared By: RBMcAndrew   Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map-At Power Proc No / Section: 2-PT-21.1	Sequence Step No: 43
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: *	RCS Temperature (°F): T_{REF} ±1 Power Level (% F.P.): <75% Other (specify) Must have ≥ 38 thimbles
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 185	RCS Temperature(°F): Power Level (% F.P.): 72.15% Other (Specify): 62.8 MWD/MTU 1.6 EFPD 46 THIMBLES
	Date/Time Test Performed: 11/7/90	

IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	3.1%, P>.9 4.7%, P<.9	1.443	1.888	1.0117
	Design Value (Design Conds)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_{\Delta H} \leq 1.49(1+.3(1-P))$	$F^T_Q(Z) \leq 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments	Design Tolerance is met : X YES ___NO Acceptance Criteria is met : X YES ___NO
	* As Required

Prepared By: RSMcCandrew   Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map-At Power Proc No / Section: 2-PT-21.1 Sequence Step No: 43	
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: *	RCS Temperature (°F): T_{REF} ±1 Power Level (% F.P.): <75% Other (specify) Must have ≥ 38 thimbles
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 185	RCS Temperature(°F): Power Level (% F.P.): 72.15% Other (Specify): 62.8 MWD/MTU 1.6 EFPD 46 THIMBLES
	Date/Time Test: 11/7/90 Performed:	

IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	3.1%, P>.9 4.7%, P<.9	1.443	1.888	1.0117
	Design Value (Design Conds)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_{\Delta H} \leq 1.49(1+.3(1-P))$	$F^T_Q(Z) \leq 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments	Design Tolerance is met : X YES ___NO Acceptance Criteria is met : X YES ___NO
	* As Required

Prepared By: [signature] Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map - NI Calibration Proc No / Section: 2-PT-22.2 2.1 / ~~2.10~~	Sequence Step No: ~~44~~ 43
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: **	RCS Temperature (°F): T_{REF} ±1 Power Level (% F.P.): 95±5 Other (specify): *
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 204 Date/Time Test Performed: 11/8/90 1830	RCS Temperature(°F): Power Level (% F.P.): 90.07% Other (Specify): 87.7 MWD/MTU 2.2 EFPD 46 THIMBLES

IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	-3.4%, P≥.9 4.5%, P<.9	1.423	1.778	1.0082
	Design Value (Design Conds)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_H \leq 1.49(1+.3(1-P))$	$F^T_Q(Z) \leq 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments	Design Tolerance is met : X YES ___NO Acceptance Criteria is met : X YES ___NO
	* Must have at least 38 thimbles for a full-core flux map, or at least 16 thimbles for a quarter-core flux map. ** As Required

Prepared By: R. McEndree Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map - HFP, ARO, Eq. Xe Proc No / Section: 2-PT-21.1	Sequence Step No: 45
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: *	RCS Temperature (^{o}F): T_{REF} ±1 Power Level (% F.P.): 95±5 Other (specify): Eq. Xe. Must have ≥ 38 thimbles
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 228	RCS Temperature(^{o}F): Power Level (% F.P.): 99.98% Other (Specify): 315.2 MWD/MTU 7.9 EFPD 1404 ppm 46 THIMBLES
	Date/Time Test Performed: 11-14-90 1400	

IV	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
Test Results	Measured Value	3.7%, P > .9 4.7%, P < .9	1.414	1.746	1.0086
	Design Value (Design Conds)	± 10% for P_i ≥ 0.9 ± 15% for P_i < 0.9 (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_H \le 1.49(1+.3(1-P))$	$F_Q^T(Z) \le 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments	Design Tolerance is met : X YES ___NO Acceptance Criteria is met : X YES ___NO
	* As Required

Prepared By: D.M. McAndrew

Reviewed By: [signature]

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map- NI Calibration Proc No / Section: 2-PT-22.2 Sequence Step No: 46				
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: **		RCS Temperature (°F): T_{REF} ±1 Power Level (% F.P.): 95±5 Other (specify): *		
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 205		RCS Temperature(°F): Power Level (% F.P.): 99.87% Other (Specify): 341.1 MWD/MTU 8.57 EFPD 26 THIMBLES / 1/4 CORE MAP		
IV	Date/Time Test Performed: 11-15-90 0600				
IV Test Results	Meas Parameter (Description)	MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
	Measured Value	*NA	NA	NA	NA
	Design Value (Design Conds)	± 10% for $P_i \geq 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_{\Delta H} \leq 1.49(1+.3(1-P))$	$F^T_Q(Z) \leq 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.[illegible].3	TS 3.2.2	TS 3.2.4
VI Comments	Design Tolerance is met : X YES __ NO Acceptance Criteria is met : X YES __ NO				
	* Must have at least 38 thimbles for a full-core flux map, or at least 16 thimbles for a quarter-core flux map. ** As Required				

Prepared By: RSMcAndrew Reviewed By: [illegible signature]

* NA because this is a 1/4 core map.

NORTH ANNA POWER STATION UNIT 2 CYCLE 8
STARTUP PHYSICS TEST RESULTS AND EVALUATION SHEET

I Reference	Test Description: M/D Flux Map- NI Calibration Proc No / Section: 2-PT-22.2	Sequence Step No: 47
II Test Conditions (Design)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: **	RCS Temperature (^oF): $T_{REF} \pm 1$ Power Level (% F.P.): 95±5 Other (specify): *
III Test Conditions (Actual)	Bank Positions (Steps) SDA: 228 SDB: 228 CA: 228 CB : 228 CC : 228 CD: 228	RCS Temperature(^oF): Power Level (% F.P.): 100.1 % Other (Specify): 358.5 MWD/MTU
	Date/Time Test Performed: 11-15-90 1700	9.01 EFPD 26 THIMBLES / 1/4 CORE MAP

		MAX. REL ASSY PWR % DIFF (M-P)/P	NUC ENTHAL RISE HOT CHAN FACT F-dH(N)	TOTAL HEAT FLUX HOT CHAN FACT F-Q(T)	QUADRANT POWER TILT RATIO QPTR
IV	Meas Parameter (Description)				
Test Results	Measured Value	NA*	NA	NA	NA
	Design Value (Design Conds)	± 10% for $P_i \ge 0.9$ ± 15% for $P_i < 0.9$ (P_i = Assy. Pwr.)	NA	NA	≤ 1.02
	Reference	WCAP-7905 REV.1	NONE	NONE	WCAP-7905 REV.1
V Acceptance Criteria	FSAR/Tech Spec	NONE	$F^N_H \le 1.49(1+.3(1-P))$	$F^T_Q(Z) \le 2.19/P \times K(Z)$	NA
	Reference	NONE	TS 3.2.3	TS 3.2.2	TS 3.2.4

VI Comments	Design Tolerance is met : X YES ___NO Acceptance Criteria is met : X YES ___NO
	* Must have at least 38 thimbles for a full-core flux map, or at least 16 thimbles for a quarter-core flux map. ** As Required

Prepared By: DSMcAndrew Reviewed By: [signature]

* NA because this is a 1/4 core map.